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New York, November 24, 1928

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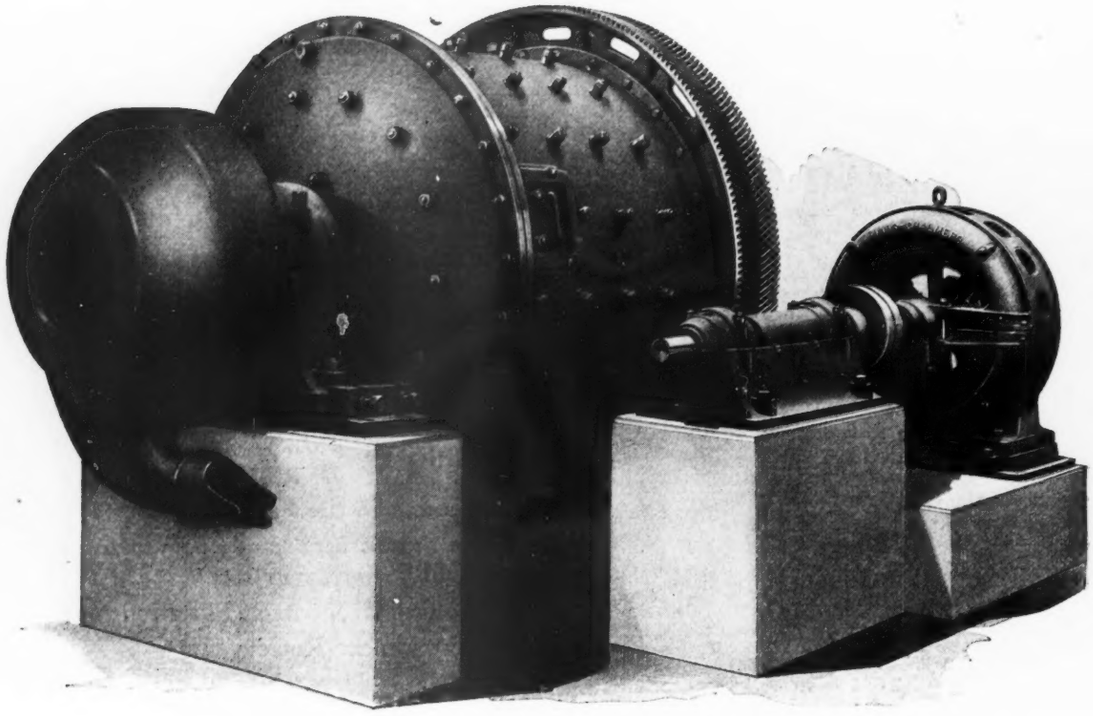

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ENGINEERING AND
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A. W. ALLEN,
Editor

VOLUME 126 — *New York, November 24, 1928* — NUMBER 21

Increasing the Cost of Mining Machinery

PROFOUND CHANGES have occurred during recent years in mines and in metallurgical and power plants. Intensive research, encouraged and sponsored by adequate publicity in regard to technical results, has led to vast economies in ore breaking, haulage, transportation, and in every phase of milling, recovery, and refining operations. As a result, ore of a grade that was considered non-commercial a few years ago is now being treated at a profit. Larger tonnages are being handled, and higher metallurgical extractions are being secured; but no one has invented a process that obviates the use of machinery at each stage of operations. In fact, although machines have been simplified and rendered almost foolproof, the number of individual units is greater than obtained in the days when gold amalgam was recovered on a copper plate, tin concentrate on a buddle, and copper by the operation of a smelting unit. Efficiency of metallurgical result and net economy of operations have been attained by an unavoidable increase in the complexity of the mechanism of the problem —a complexity, however, in design but a simplicity in operation that has reduced manual labor to a minimum, decreased personal accident hazard, and simplified control.

The mechanization of mining and metallurgical methods has been well worth while, because it has shown an abundant additional profit to the industry. The success already attained, however, should encourage further efficiency and frugality in regard to all expenditures, even those of indirect influence. In this connection attention should be directed to the danger of increasing the cost of mining machinery by illogical and unfruitful publicity expenditures. This comment is prompted by a decision recently made by a prominent engineering school to embark on an intensive campaign of advertising solicitation, in behalf of the school magazine, conducted with the aid of and urged on by the loyalty of the alumni toward their alma mater. Better far for manufacturers to keep such payments distinct from publicity expenditures by applying them in their entirety to the institution in question—as a contribution outright, rather than in the guise of appropriations for advertising.

Any increase in equipment cost constitutes a danger to the industries now being served by recognized media of publicity; and, if pushed to a conclusion that may be deemed successful from the restricted viewpoint of the sponsors of the latest type of incursion into the publishing business, the move will surely add to the cost of machinery. Moreover, it will not help the advance in the modernization of methods achieved through many years of intensive effort on the part of those who have supported and produced the leading journals of opinion and practice. An alumnus magazine is an appropriate medium to sustain comradeship between classmates and to remind graduates of their obligations to the institution of learning that started them in professional work. But when loyalty to the alma mater is commercialized by a campaign urging alumni to write to advertisers, to apply for booklets and catalogs whether they are needed or not —all serving to create an impression of buying power that would seem to justify an increase of advertising appropriations or a diversion of existing appropriations from publications that have served the field through periods of industrial depression as well as during normal times—that higher loyalty without which no profession or industry can prosper may properly be enlisted and urged to appropriate action.

Indiscriminate publicity expenditure is more dangerous than no publicity at all. A simple calculation only is needed to show that—disregarding the evaluation of the editorial appeal of an alumnus magazine as compared with that of an established journal, on which appeal the returns from such publicity must depend—the cost, which ultimately is borne by the user of the product advertised, to reach each individual among the subscribers to a limited-circulation monthly, is out of all proportion to the maximum result that could be expected. The outcome, from every standpoint, may be condemned as wasteful, constituting a disregard of the fundamental ideals of the engineer.

Echoes of the Election

TO MINING ENGINEERS, as to others, the outstanding event of the recent national election was, of course, the success of Mr. Hoover, but some of the other returns are of particular interest as well. For instance, in Utah, Mr. George H. Dern — mining engineer, mine manager, metallurgist—was re-elected Governor, notwithstanding the fact that he was running on the Democratic ticket and that the state voted for Mr. Hoover for President. The engineering habit of mind, combined with Governor Dern's good record and attractive personality, has appealed to the people of Utah, and, as expected, they continued their support of him, even though a wholesale splitting of tickets was necessary. Most of our readers know that Governor Dern is the Dern of the Holt-Dern chloridizing roast process, but he has many other accomplishments in the mining field to his credit.

In Arizona, many engineers will be interested to learn that Governor George W. P. Hunt was defeated for reelection, the Republican candidate, Mr. John C. Phillips, floating in on the Hoover tide. Though Governor Hunt

was never directly connected with mining, he was a resident of Globe, a mining center, worked for a time in the Old Dominion store there, and has had intimate contact with the mining industry of the state in his various terms as Governor, which date from 1912, when Arizona was admitted as a state. Governor Hunt's decisions have not always been pleasing to the mine operators, and presumably they are looking forward to the incumbency of the Governor-elect. Press reports indicate that Governor Hunt's opposition to the Swing-Johnson bill may have had something to do with his defeat, though this is to be doubted, as the proposed legislation was not considered a party matter, and the provisions of the bill were considered to be too favorable to California to have very wide acceptance in Arizona.

A third item of interest to those of a scientific turn of mind is the defeat of Charles Darwin in Arkansas. Though Mr. Darwin has long since departed from this mortal sphere, his theories live on and are in large part accepted outside of the borders of Tennessee and, now, Arkansas. As the New York *World* puts it: "The voters of that state were called upon to express their preference not only as between Smith and Hoover, but also as between Genesis and biology. Genesis won by a substantial plurality. The electorate declared overwhelmingly against permitting the teaching of evolution in any institution supported by public funds. Henceforth the school teachers and university professors of that state must either keep quiet about the origin of the human race or else assure young Arkansans that their common parent was Adam and not protoplasm." Which states the case succinctly.

Segregation and Compilation of Geological Data Are Essential

MODERN INDUSTRY demands that technical information be easily and immediately available. This applies to statistics as well as to data of a more scientific and less easily classified character. In this latter class is geological information, now obtainable through official and unofficial sources without laborious delving into dust-laden archives. Examples of this kind of work are the state geological maps of Arizona and California. Geological research in Arizona in 1924 reached such a stage that a geological map of the state became practicable and was prepared by the collaboration of Mr. N. H. Darton, the Arizona Bureau of Mines, and others. A geological map of California, of value to oil geologists and mining men, was prepared under the direction of Mr. J. B. Smith in 1916.

Recently the United States Geological Survey published a bulletin on the geology of the Muddy Mountains, in Nevada, written by Dr. Chester R. Longwell, the field work in connection with which was made possible by an expenditure from the Dana Research Fund, of Yale University. Potential resources of magnesite, clay, and gypsum exist in this area, which lies north of the great bend in the Colorado River. Rock salt is produced in Virgin Valley. Copper ore has been mined, also; and in 1910 Mr. Howland Bancroft reported the occurrence of platinum in association with low-grade copper ore, northeast of St. Thomas. The principal interest, however, is geological exploration, as the region lies between the Grand Canyon and Great Basin areas. Reconnaissance surveys of southwestern Nevada were made by Mr. Clarence King, in 1872; by Mr. G. K. Gilbert; by Mr. J. E. Spurr, in 1903; by Mr. S. H. Ball, in 1907. Available also are the more specialized geological reports of mining districts in the Great Basin. Other parts of the state have likewise been studied.

The material for a geological map of Nevada is available; its preparation should not be delayed. Additional geological research will undoubtedly be necessary, but the United States Geological Survey, in co-operation with state agencies, is in a position to conduct this. Much existing information, scattered in numerous publications, many of which are almost impossible to obtain, can also be utilized. Not only the mining industry, to which Nevada is so closely bound, but every other industry in which geology plays a part, should benefit from the compilation of a state geological map.

Making Efficient Foremen Out of College Graduates

COLLEGE GRADUATES do not usually become foremen, but it would be profitable to industry in general, and to the mining industry in particular, if more foremen were systematically developed out of graduate material. It has been done on occasion, but usually because of necessity. The graduate, unable to get work with the engineering staff, takes a job as miner; and then, if he possesses the necessary zeal and initiative, he accumulates experience by contact with every-day operating problems, and reaches a position to which the manager has been only too glad to advance him. This is both fortuitous and fortunate for the mine, because the graduate brings with him a substantial background of knowledge and training incurred at no expense to his employer.

Not all graduates provide good foreman material, nor do the majority seek to make their entry into the industry by the muck-stick and trammer route. Many mining companies do not give adequate or sympathetic consideration to the mining graduate looking for a toe hold in the industry. To take a young fellow out of the modern college atmosphere and to transfer him to the environment of the ordinary mine worker presupposes a degree of fortitude and innate toughness on his part that is relatively scarce. Times have changed, and the status of the mine foreman has also changed. Systematic consideration has supplanted chance, and good organization has replaced haphazardness. It is therefore essential to place the development and training of foremen on a new and improved status.

The mine manager should more definitely commit himself by inducting young graduates into his organization as staff cadets. He should provide a definite contact of these young cadets with its operating officials and engineering staff. The graduate, of course, will go through the successive steps of mucker, miner, timberman, and so on. He should serve his apprenticeship, but the surroundings should be improved so as to act as an incentive and an inspiration to hold his interest through the period spent in acquiring mining experience and familiarity and contact with other workers. He should be

given opportunity for directing operations, and a growing sense of responsibility should be progressively developed. The outcome may not result in a good mine foreman in all instances; nor should it be expected that, if a good foreman be developed, he will remain ever after in such a position. If possible, he should be advanced to assistant superintendent; or, if other positions outside the mine are available, he should be given the opportunity to develop ability sufficient to enable him to aspire to them.

Mining Laws of the World and Where to Find Them

KNOWLEDGE of the laws of a country is necessary to the proper conduct of mining or any other business. Failure to accept this truism leads to mistakes and delays that are sometimes costly. Not that every man should be his own lawyer, for then in most cases he would possibly have a foolish client, in accordance with the adage; but an understanding of the fundamentals of procedure will surely smooth the path for any enterprise, especially in a foreign country. If such knowledge be difficult to obtain—if the law be obscured in mystery—the effect will be to put a brake upon the development of that country.

Those desirous of promoting the utilization of resources will seek first to disseminate knowledge regarding them and the laws under which they may be worked. Aside from our own Geological Survey, a notable instance of frankness is afforded by the British government in its systematic effort since the war to collect and publish data regarding the mineral resources of the countries within that commonwealth and the laws controlling them. The former were the first to receive consideration; the series of bulletins brought out by the Imperial Mineral Resources Bureau is now well known. Of greater practical value, perhaps, is the monograph on the "Mining Laws of the British Empire and of Foreign Countries," publication of which was undertaken by the Imperial Institute in 1920, when the two volumes on the laws of Nigeria and West Africa appeared. Following these at intervals have come other numbers of the series: on the Transvaal and on British Columbia, in 1922; on Swaziland, in 1923; on Victoria and British India, in 1924; on the Malay States, in 1925; on the Orange Free State, East Africa, and the Dominion of Canada, in 1927; and on British Guiana and Ontario, in 1928. A volume on New South Wales and doubtless others are in course of preparation. That on Ontario is typical of the series, the subjects covered including prospecting, location of claims, forfeiture; agreements, trusts, and transfers; disputes; patents and crown leases; fees, rents, royalties, and taxes; ancillary rights; and the employer and employed.

Inspection of this series leaves one with the impression that nowhere else can be found something quite as good. Nothing has been published in the United States with respect to the laws governing mining in the individual states that is as thorough-going and up to date. These bulletins may be regarded as the fruit, in part, of the Empire's post-war resolve to know itself and its resources better.

The Borderland Between Ore and Waste

ORE, as distinct from waste, is raw material that can be mined, or mined and treated, at a profit. But some of the waste of today may be the ore of tomorrow, as the result of the introduction of more economical and more efficient methods, by the substitution of machines for men, or because of an appreciation in selling price of the final product. Some term is therefore needed to describe this borderland material.

Mining and Scientific Press suggested "near-ore," but the proposal made no headway, possibly because of the fact that the term prompted thoughts of a substitute beverage, the name of which, many have maintained, was selected by someone who was evidently a poor judge of distance!

Engineering and Mining Journal suggests the term "subore." The prefix means "below" or "under." A mental picture is therefore offered, for example, of a chart or graphical analysis of a mineral-bearing deposit, in which the material that can be treated profitably is separated from the material that cannot be treated profitably by a flexible line of demarcation depending on various economic factors for its placement. The problem for the miner and the metallurgist is to maintain the placement of the demarcation line as near the bottom of the chart as is practicable. The scope for initiative is made more obvious than if the borderland material were termed waste, which, to some extent, connotes an acceptance of finality that lacks optimism.

The Passing of the Old Guard

IN A LIST of those who have brought honor and credit to the mining industries by the high standard of their prefoessional work abroad as well as at home the names of the brothers Hennen and Sidney J. Jennings may well be included. Both were prominently identified with the development of the gold-mining industry of South Africa toward the latter part of the nineteenth century; and to Hennen Jennings, in particular, was due to a considerable extent the rapid progress made there in the evolution of an efficient and economical metallurgical technique. To a broad educational training was added a mental inquisitiveness that served to contribute to the economic and technical advance in the various branches of the mining industry with which they were connected, and each was generous in the measure of his public service.

Hennen Jennings died on March 5, 1920; Sidney J. Jennings, we announce with deep regret, on November 17, 1928, at his home in New York. Thus the mining industry loses a distinguished and genial leader, who had filled the position of president of both the A.I.M.E. and the American Mining Congress; and *Engineering and Mining Journal* laments the passing of a friend and critic whose summary on the gold and silver industries, in the annual review number, was always an outstanding contribution to the publication and to the broad geographic field of readers it covers. A biographical sketch of Sidney Jennings' career appears on another page of this issue.

South America's Leading Mining Industry.....N

The nitrate rock, usually found near the surface, is loosened by an explosive and then sorted by hand on the majority of the properties

* * *

Mining the caliche, or nitrate rock, is preceded by blasting with a crude gunpowder

Chile's major source of revenue offers promise of increased yield at lower average production costs . . . Reserves of raw material are adequate for several generations . . . Scope for improved technology.

By A. W. ALLEN
Editor

EARLY in the nineteenth century a party of Indians traveling across the arid wastes in the north of Chile discovered a rock that had the property of feeding the flames of their camp fire. Suspecting the influence of an evil spirit, they hurried to the priest with a sample, seeking from him such interpretation as knowledge and wisdom might proffer. What transpired at the conference is not recorded, but history relates that the sample was thrown into the garden, which later attracted attention because the plants growing in the immediate vicinity of the discarded stone flourished amazingly, in marked contrast to the condition of the others. Investigation then revealed that the "fire rock" also contained a plant food with remarkable powers.

The legend of the Indians and the priest may be taken to mark the birth of what is now an industry of immense proportions, the products of which are being shipped to the far corners of the earth. The ambitious nations of the world all keep an eye on Chile, remembering that it was an abundance of Chilean nitrate that helped to win the war for the Allied-American forces; that it was an exhaustion of stocks of that valuable substance in Central Europe, and the impoverishment of Teuton soil, that helped to hasten the armistice. Agriculturalists swear by natural nitrate as the most desirable basic constituent for fertilizers. Politicians and lobbyists ignore its existence when clamoring for their own desires as to the disposition of the Muscle Shoals plants. Uninformed scientists and provincial publicists have maintained for a quarter of a century or more that the Chilean deposits are on the verge of exhaustion.

Seemingly oblivious to pro-synthetic boasts and power-

A reproduction from "Stevens on Stowage," which shows how nitrate was carried from wharf to lighter at Iquique about the middle of the 19th century

..NITRATE

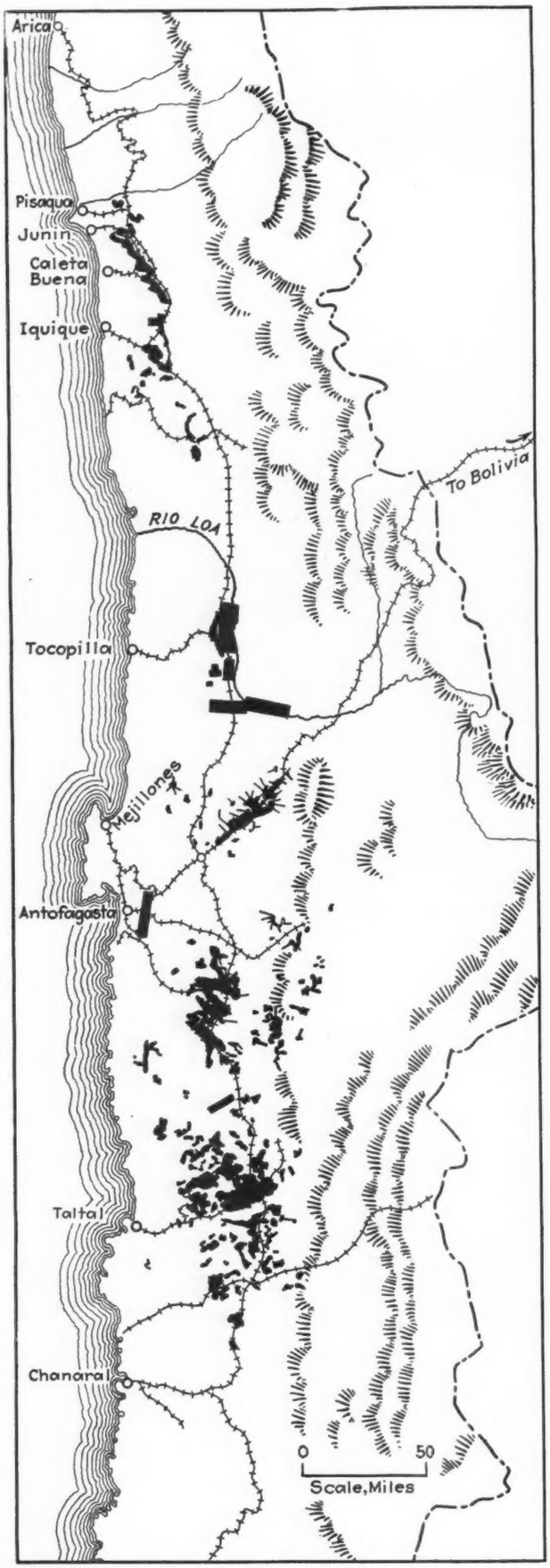
ful propaganda, Chile forges ahead steadily, contributing largely to the increased traffic through the Panama Canal in meeting insistent demands for the product of its basic industry from Europe and Egypt. Germany's imports of Chilean nitrate are also rising, but so are the exports of her synthetic substitutes, which customers learn are "just as good," if not better! The United States, apparently, cannot do without the natural product. In the first six months of 1928 was registered an increase in Chilean nitrate imports, as compared with the same period last year, of 93.6 per cent in quantity and 64 per cent in value. As a result of these tendencies, inquiring eyes are being turned toward the leading South American mining industry. Are the Chilean deposits so near exhaustion that the world must depend in the future almost entirely on nitrogen from the air? What are the prospects for cheap nitrate, bearing in mind the history of the synthetic industry, sponsored as it has been by the world's greatest chemical and engineering experts and encouraged by vast government and private expenditures, but complicated by the need for intricate and elaborate processing methods and attended by hazards unknown in the production of the refined natural product?

The fact must be faced that Chile, with a virtual monopoly of natural nitrate of soda, is in a particularly fortunate position, being able to supply almost unlimited quantities of an essential war material and a peace-time commodity of vast importance to agricultural and commercial development. The nitrate industry of Chile, which has helped to bring that country to the front rank of progressive nations, employs about 100,000 men. It has transformed a barren desert into a region of technical activity and intensive development, stimulating the growth of attractive coastal towns and railroad facilities, and contributing to the government, by means of the nitrate and iodine export taxes, over 40 per cent of the nation's income. Since 1880 the total sales of Chilean nitrate of soda have aggregated about 80 million short tons, worth nearly three billion dollars. The export tax on nitrate, now between $10 and $11 per ton, has in the past contributed as much as 80 per cent to the government's revenue.

The arid region of Chile that lies north of Chañaral and between the coast line and the high Andes is a chemical storehouse. Of the two principal products, nitrate and iodine, one is the source of many explosives such as were used in the Great War, and the other helped to

Plant of the du Pont Nitrate Company, where hydro-metallurgical, bulk-leaching methods were first introduced for the recovery of nitrate

Map of northern part of Chile, showing where nitrate beds have been found, and illustrating opportunity for coastal power plants



heal the wounds that resulted. The commercial exploitation of the deposit began in 1830, in which year a small amount was exported. The growing importance of the industry was realized and translated into action in the late 'seventies, when Antofagasta was a Bolivian town, serving as that country's outlet to the Pacific. The nitrate fields, largely exploited by Chilean interests and Chilean capital, were in the districts or provinces of Antofagasta, Tocopilla, Taltal, and Aguas Blancas, belonging to Peru. The war of 1879-82, between Chile and the combined forces of Bolivia and Peru, resulted in a decisive victory for Chile and a rearrangement of frontiers in that part of the world. Bolivia was pushed back into central South America, losing Antofagasta and access to the sea. Peru was forced to give up her nitrate deposits to Chile, thus paying the most colossal indemnity that has ever been demanded and received at one time by a victorious nation.

Many years before the fateful August of 1914, Germany had been accumulating in the soil and above it an immense store of nitrate, recognized as a valuable plant food and as a vital necessity in the waging of a war. Not being content with what might have been considered ample provision, preparations were made to meet all contingencies, even to the possibility of the cutting off of supplies from Chile. Huge plants were designed and erected to abstract nitrogen from the air, and then to make a nitrogen product by synthesis. Teutonic foresight in this respect was fully justified by later events; and although an early success was achieved in the destruction of a squadron of the British Navy under Admiral Cradock on Nov. 1, 1914, not far from the Chilean nitrate deposits, the tables were turned soon after by a decisive British victory near the Falkland Islands. After that episode there was no doubt as to the impossibility of Germany obtaining nitrate from Chile so long as the war lasted, with the Allies in virtual command of the sea; and thereafter the Central Empires had to depend on their stock of Chilean nitrate and on synthetic substitutes, for the manufacture of which such elaborate provision had been made. In this respect Germany took the lead. Almost all the civilized nations of the world needed nitrate, but none other than Germany had considered the probability of complete isolation from Chile and an urgent demand for explosives at one and the same time.

The nitrate pampa is bereft of life except in those parts where industry hums and where the nitrate railroads carry food and materials to the workers in the parched regions inland and bring back the refined product to the coast. Away from the treatment plants and working nitrate grounds the scene is desolate; the ground, arid. Ravines are always dry. Rain is unknown except at rare intervals of several years. A persistent downfall would cause complete disorganization. On the other side of the Andes I have seen lightning, attracted by a highly mineralized outcrop, open the heavens; but in the Chilean nitrate region no such attraction exists, the hills for the most part being covered with loose sedimentary matter.

Wild life is almost extinct. Darwin—and few things of interest escaped the eagle eye of so observant a naturalist—after diligent observation could find nothing more than a small lichen growing on the bones of a dead mule. Flies are troublesome, but fleas and other undesirable "outside passengers" prefer the mild, sea-level atmosphere of a coastal town such as Antofagasta; and when their hosts, the *rotos,* or working men of the nitrate pampa, leave the port to go back to duty, it is

natural to suppose that many of the vermin go with them. But with the increasing elevation and aridity, they become uneasy; and rumor has it that when the train reaches the first stop in the stiff climb they get off, cross the line to the down platform, and return coastward, in company with those *rotos* who are on their way to a lower and more congenial altitude!

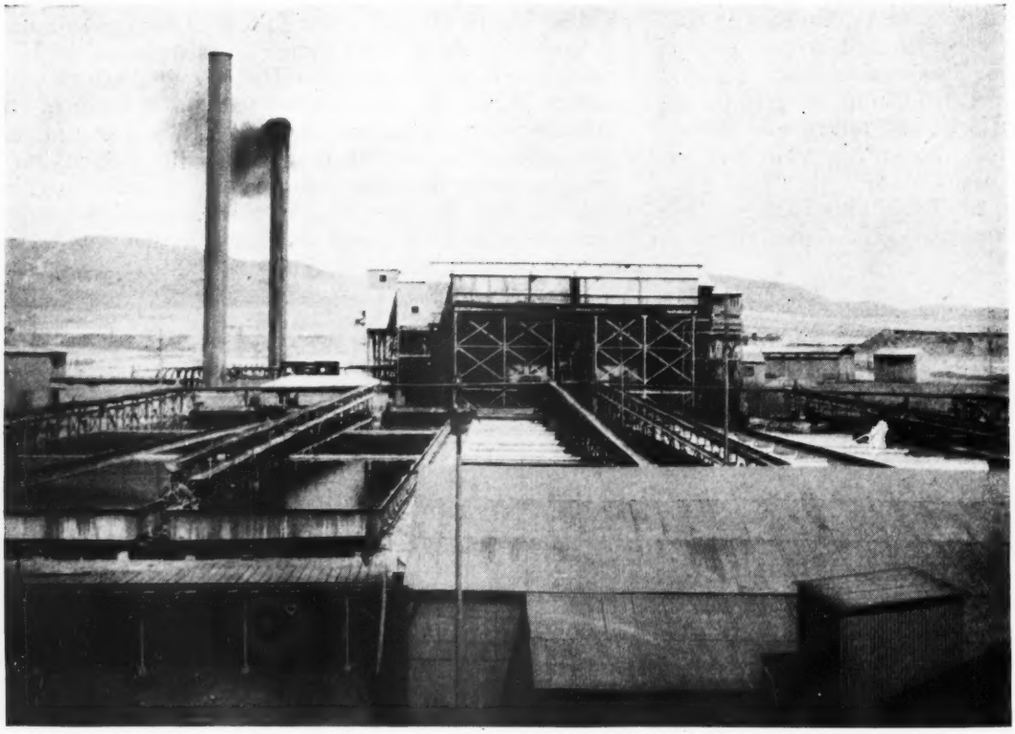
Why so noticeable an aridity in this part of Chile? The answer is not far to seek. The coast line in the latitude of the nitrate pampa, and to the north as far as Peru and part of Ecuador, is washed by the Humboldt current, the coldness of which is due to an upwelling from lower strata in the sea, and not, as popularly supposed, to the fact that it comes from the south. The water-laden air from the Andean cordilleras passes rapidly and at a high elevation over the comparatively narrow strip of land comprising Chile; and, meeting little warmth there or along the coast, it does not precipitate. Between December and April, however, a warm current—*El Niño*—comes down from the north. Periodic changes of climate and torrential rains in regions ordinarily arid have occurred because of the conflict between these opposing currents and the southerly advance of *El Niño*. Pizarro's march to Cuzco, preceding the Spanish conquest of Peru, may have been possible only because he unconsciously chose a period following an unusual rainfall of this character, in what is known as *un año de abundáncia*. In 1925, *El Niño* pushed the Humboldt current so far south that disastrous floods occurred, and the coast line became unrecognizable in parts of Ecuador and Peru, even to the northern borders of the area in dispute to the north of Chile. History records short but heavy rainfalls in the nitrate regions in 1819, 1823, 1852, 1859, 1878, 1903, and 1911.

Many conflicting theories have been expounded to explain how the nitrate came to be there. One of the commonest suggests that in earlier times what is now the nitrate pampa lay below the Pacific Ocean, and that its emergence resulted from some colossal upheaval on land or recession of the water. The nitrate deposits were then formed, according to this theory, as a result of the decomposition of marine matter. Much evidence has been adduced in support of this contention, which, however, meets with little favor among scientists. It is claimed that the skeletons of fish and other marine animals have been found imbedded in the *caliche*, or niter-bearing rock, but I have never seen one myself. Iodine is found throughout the nitrate pampa, and its association with seaweed is well known.

General view of nitrate port

Certain parts of South America are noted for guano deposits, notably Chile and Peru. To those whose experiences have not included a trip down the west coast it is difficult to convey an impression of the number of birds that may be seen. I once spent several days in the harbor of Mejillones; and from the deck of the steamer I watched, fascinated, for hours at a time, the gyrations of vast flocks. So great was their number that the sky in broad daylight would darken as if the sun were setting. Guano occurs in many places, especially on islands near the coast; and an additional theory to account for the formation of nitrate suggests that it was caused by decomposition of the excreta of birds, in combination with sea salt.

It has also been proposed that the nitrate resulted from the fixation of atmospheric nitrogen by lightning, or by the activities of nitrifying bacteria in alluvial soil, or from the concentration by evaporation of the traces of salts contained in the ground waters descending from the Andes. What appears to be the most adequate theory advanced to date maintains that volcanoes are responsible. The oxidation of released ammonia formed nitric acid. This, in combination with alkaline earths resulting from rock formation, produced the nitrate. Iodine is not a common constituent of volcanic emanations, however,



A modern Shanks maquina or nitrate plant

and its presence in Chilean *caliche* seems difficult to explain. The problem of the genesis of nitrate is not yet fully solved.

Little attention was paid to the Chilean nitrate industry during the early years of exploitation, because of the inaccessibility of the deposits; and the investment of capital was condemned as a foolhardy speculation. The final product was carried to the coast on the backs of mules, at a cost that was well-nigh prohibitive. Since then, however, several railroads have been built. The principal southern line, the Antofagasta & Bolivia, is still run on narrow-gage rails. All the principal nitrate regions are now served with rail connection to the various ports, where the product is loaded on steamers and sailing vessels, some of which carry it a distance of more than 6,000 miles.

The west coast of South America is still deficient in loading facilities; and all cargo north of Valparaiso has to be delivered from lighters alongside the ship. This, however, is an improvement over earlier methods. My grandfather (Robert White Stevens), whose book on stowage was published in 1858, describes how "nitrate is brought off at Iquique and Pisagua in boats called 'balsos.' They are about ten or twelve feet long, are formed of skins, and shaped something like a canoe, but rise more at the ends. . . . Two of the balsos are fastened side by side. . . . The bows being near the water's edge, and the balsos inflated, a boatman seizes their after ends, and waiting the approach of a heavy roller, launches his frail craft on its crest, and at the same time places his knee on the stretcher aft. In this position he goes out on the roller, and at the proper time

Crystallizing vats, in which the hot liquor is cooled by exposure to the atmosphere

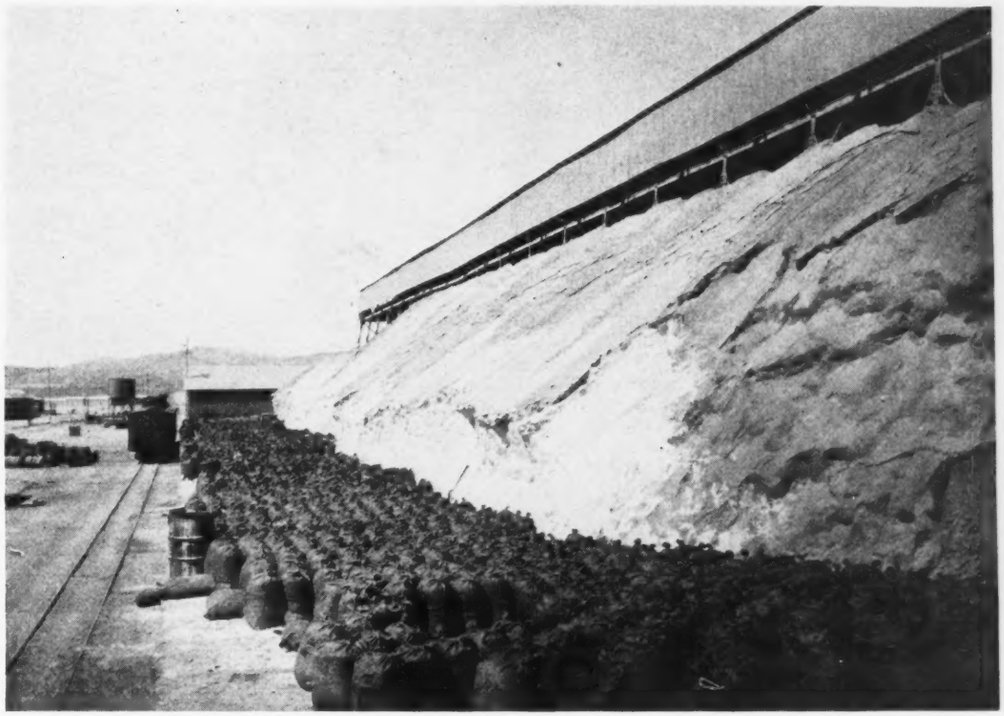
takes up a paddle. . . . which he uses adroitly. . . . and thus propels and steers at the same time. He dare not stand upright, or the craft would be liable to capsize, as it draws only three or four inches of water. At 30 or 40 yards from the beach, the nitrate is delivered into the ship's boats, which, when they have obtained, say fifty bags, proceed to the ship, into which they are hoisted by the usual purchase of the winch."

Being an observant man, my grandfather noticed that the ship's cat, on arrival in London of a barque carrying nitrate, was "much wasted, it is supposed by inhaling the vapor of the cargo when chasing vermin."

The nitrate is found widely distributed in different degrees of concentration in superimposed horizontal layers, what is known as the *caliche* stratum, being comparable, so far as value is concerned, to the ore vein in a metal mine. *Caliche,* however, is usually only a few feet thick, and the tonnage available per unit of area, though variable, is strictly limited. It is therefore obvious that collection and transportation problems inhibit the successful utilization of methods found applicable and satisfactory for the exploitation of large masses of ore. By the same token, it is not advisable, in view of the immense capital cost that would be involved, to concentrate treatment operations to an extent that would necessitate abnormal outlay for freighting the raw material to the plant.

Mining methods in general use throughout the industry are crude, although it is to be recorded that successful attempts have been made in recent years, despite local scepticism, to introduce modern equipment and labor-saving machinery. Power drilling, prior to blasting, will eventually become standard practice. Electrically operated shovels and buckets will find wider application in replacing the laborer at the "mine" or in the plant. Automatic and continuous methods of crystallization, with the recovery of most of the heat in the high-temperature solutions, this heat being now dissipated into the atmosphere, will effect large economies and result in the delivery of a more uniform and better-grade product.

In spite of the favorable climatic conditions and the relative shortness of the distances between the nitrate deposits and the various ports, large-scale electrification projects and the construction of central power plants await initiative and planning. A glance at the map of Chile, known as the "tapeline" republic, will show how favored are the port towns as potential sites for electric power-supply stations, to deliver current to the port-to-pampa railroads, and to the nitrate grounds and plants inland. Development of the Chilean coal industry in accordance with modern methods would be a complementary move, of immense advantage to the country, directly and indirectly.



Nitrate in storage and sacked ready for shipment

Only one railroad to the nitrate pampa is electrified, and it carries the oil needed for the production of electric current. The opportunities for economy in every stage of operations in the average nitrate region—in mining, processing, and transportation—are such that a heavy investment for up-to-date coastal electrical plants would prove highly profitable to all concerned. The scope for electrical traction between plant and nitrate grounds is equaled only by the opportunities that exist for the use of electricity in every phase of handling the raw material and final product.

Chilean nitrate, as an essential world commodity, attracted little notice until 1898, when intense interest was aroused by Sir William Crookes at a meeting of the British Association for the Advancement of Science at Bristol, England, who affirmed that in twenty to thirty years the normal-grade reserves in Chile would be gone, and that in fifty years the world would be facing starvation for lack of fertilizer, unless appropriate overtures were made to the chemist.

Sir William's standing as a physicist was and is unquestioned, but he was a poor prophet. Nearly thirty years have passed since the pronouncement. In the interval, over sixty million metric tons of Chilean nitrate,

valued at about two and a half billion dollars, has been sold. Today the industry is in a far better position to supply nitrate than it was in 1897, when the output aggregated little more than one million tons. In fact, it can prove, as the copper industry has proved, that a combination of low-grade ore and modern mining and processing methods offers greater scope for cheap production than does the exploitation of high-grade ore and the retention of a primitive mining and recovery system.

The Crookes prophecy, despite its lack of verisimilitude, gathered momentum by reason of the eminence of its sponsor and by frequent and unthinking repetition; and, notwithstanding the passage of time and the gradual expiration of the period before the catastrophe was scheduled to happen, the statement that the Chilean nitrate industry was on the verge of extinction was repeated in authoritative quarters as late as 1920, by writers of books and by officials of government departments. In 1921 a serious attempt was made to combat the propaganda. In 1922 a U. S. Department of Commerce report was issued, based on a careful study, which affirmed that the reserves were at least adequate for several generations, and from this it became evident that the amount of nitrate awaiting recovery in Chile was still too vast to permit computation. Incidentally, this report took no account of the nitrate available in the residues from older and less efficient processing methods; but it should be remembered that research has demonstrated that this reserve, valued at about one billion dollars, can be recovered by cheap methods if large-scale practice and modern equipment be used. The dumps, scattered throughout the length and breath of the nitrate pampa, are alongside plants that can be modified to handle large unit charges by a process adapted from proved practice in the hydrometallurgical field. This statement prompts a brief excursion into modern metallurgical history.

One of the romances of gold lies in the story of two physicians and a chemist working at nights in a Glasgow basement in the 'eighties, intent on the discovery of a process that would recover the precious metal being lost in the tailings from the inadequate methods of ore treatment then in vogue. Success crowned their efforts, and rewarded, in reputation if not financially, those who first put the cyanide process to work on a large scale in South Africa. As a result, the world's output of gold was doubled in ten years, and a vast tonnage of residue and low-grade ore was made available for commercial exploitation. It was not until 1921, however, that the same fundamentals were applied in modified and expanded form to the treatment of Chilean *caliche;* and what is known as bulk leaching was adapted for the commercial recovery of nitrate from a deposit of raw material in the Taltal pampa. The only alternative complete process in use at that time was the Shanks system, which had persisted as standard practice since its introduction in Chile in 1876, and still persists in the majority of nitrate plants, although it is as inadequate as was the process that preceded cyanidation in the treatment of a gold ore.

The plaza at Antofagasta, Chile

One of the romances of copper, a sister industry to Chilean nitrate, lies in the amazing achievements of recent years in converting mountains of discolored stone into profitable reserves of ore, the successful accomplishment of which should be credited mainly to the adaptation of those fundamentals of simple though scientific processing developed by early cyanide engineers, supplemented by an adventurous and technical inquisitiveness that led to the adoption of large-scale operations, the development of an elaborate technique, and the perfection of electro-chemical methods of final recovery. These great achievements in metallurgical engineering have followed intensive efforts to succeed where others have failed.

Merely to make easy money, or to spend it lavishly to solve an elementary problem of obtaining large profits from what already is rich, has no fascination for the engineer. Chile's copper industry, in particular, has passed into an era of scientific control, whereby the lowest costs obtain, per pound of copper recovered, in the treatment of low-grade ores. The nitrate industry will undergo the same transformation when the rich *caliche*

deposits are exhausted; when science, technical experience, and common sense, coupled with a care in capital expenditure that keeps the economic goal in sight, will convert the vast reserves of low-grade ore and residue into dividends. The wealth that Chile possesses in the dumps of residue from the Shanks process of nitrate recovery has escaped the attention that would have been given to the subject had the natural nitrate industry been faced with serious competition. Progress in some industries, especially in Latin American countries, cannot be hurried; and it is perhaps as well that a process which successfully supplanted the primitive methods in vogue in the earliest days of the development of the Chilean industry, and paid immense sums as dividends to stockholders over a long period, should have left so much for future generations to recover.

To quote from the U. S. Department of Commerce report issued in 1922, following an investigation by Dr. H. Foster Bain and Mr. H. S. Mulliken: " . . . for the industry as a whole the recovery is undoubtedly of the general order of not more than 65 per cent." Prior to that survey the results were unquestionably worse, so there can be no doubt as to the vast amount of nitrate remaining in the dumps resulting from an inefficient process that was responsible, however, for a total production of more than 80,000,000 tons of commercial product.

The Chilean nitrate industry has been a highly profitable one, as reference to statistics will prove. The Bain-Mulliken report draws attention to the fact that "Individual companies have been capitalized on the basis of expected returns rather than with reference to cost of land and equipment, and, even so, dividends have amounted to more than 100 per cent in a number of cases. Reserve funds have also been built up, and in the case of certain companies it has been necessary to revalue the lands in order to raise the capital to some apparent conformity to dividends paid." This being the case, the lack of technical and engineering advance until comparatively recent times should occasion no surprise.

The largest Chilean company is the Compañia de Salitres de Antofagasta, which, according to the report cited, produced 4,500,000 short tons of nitrate in the period 1871-1922, inclusive. The profit amounted to 40 per cent per annum on the average capitalization for the period.

Production of Chilean nitrate to date may be valued roughly at four billion dollars. The most conservative estimate possible, assuming a much higher recovery than is generally conceded, indicates that at least 20,000,000 tons of nitrate remains in the dumps—in the form of a clean, sorted and stacked reserve of ore, conveniently arranged in piles, each of several million tons. With the history of the gold and copper industries in mind, it is unthinkable that the opportunity for industrial progress and technical achievement in this direction will be neglected for long.

Chilean nitrate lacks a natural competitor. No other deposit of economic extent is known in any other part of the world, despite thorough search in all likely regions, especially during the war period of 1914-18. The industry possesses many unique assets and advantages: The world's requirements in iodine can be supplied from the same raw material, at small cost, this element being recovered as a byproduct. Nitrate can be manufactured at negligible hazard to human life and property. It is non-flammable, despite popular opinion misled by the knowledge that fires have occurred on board steamers, but forgetful of the fact that no combustion can result without contact with some carbonaceous material such as jute. Eventually, Chilean nitrate of soda will be shipped in bulk, thereby eliminating all hazard and affecing immense economies in bagging and transportation expense. It is also non-explosive. The total hazard in production and distribution is no more than need be expected in any ordinary manufacturing enterprise. High pressures play no part in recovery or refining. Pessimists inclined to predict the failure of the Chilean nitrate industry in the face of substitute competition should bear these facts in mind.

The economic control of the Chilean nitrate industry is a story by itself, for a detailed history of which space forbids. The present situation is of major interest. It is best summarized by repeating the opinions of Mr. A. F. Brodie James, who has specialized in nitrate and who compiles a yearly statement of "Nitrate Facts and Figures," published in London, the center of the world nitrate market. In a preface to the latest edition, Mr. Brodie says, *inter alia:*

"Here was an Association of Producers who, over a long period of years, had bound themselves together upon terms which practically drew no distinction between the strong and the weak, the chief object being to limit output to a figure that would meet demand at a price sufficient to give a profit to the dearest producer. This philanthropic method of protection naturally led to the erection of many factories for whose existence there never was any real justification, and their appearance involved the cutting down of output in order to make room for the newcomers, while production costs generally rose as a consequence. Clearly this was tantamount to putting a premium upon inefficiency at the expense of the consumer, and it is not surprising that consumption failed to expand in accordance with the merits of the article produced. As time went on, and difficulties increased, many producers became obsessed with the importance of buying more land and putting up more factories in order to claim a larger quota, forgetful of the fact that, extended to the *n*th degree, such a policy was equivalent to committing financial suicide."

The Association was dissolved on April 14, 1927, when the Chilean government insisted on a reversion to free selling. This move had the desired effect on the economic situation, releasing enough nitrate to act as an incentive to increased sales as its sphere of acceptance widened. Demand strengthened accordingly, yet the synthetic interests failed to see the "handwriting on the wall." An international conference de luxe for synthetic manufacturers was planned aboard the palatial North German Lloyd steamer *Lutzow,* while a cruise was being enjoyed in the Adriatic. Rumor had it that the purpose of the jaunt was to make the world sit up and take synthetic nitrogen products as and how prescribed by the promoters, and to come to an amicable agreement about prices and territories. At the last moment a belated invitation was extended to Chile—in furtherance of Germany's desire to enlist the natural-nitrate producers as partners rather than to face them as competitors—which elicited a courteous refusal. With so many trump cards in reserve, a compromise agreement entered into by the Chilean nitrate authorities at that stage—last May—would have meant a forfeiture of income and a curtailment of opportunity. Conditions improved and sales increased. Centralized selling at a fixed price was resumed late in August, and the year 1928 promises to be the most prosperous in the history of the

industry. Sales made in Chile for export to various parts of the world during the nitrate year ended June 30 aggregated 3,000,000 tons—the largest amount for any twelve months except in the war years of 1916, 1917, and 1918.

One of the most interesting aspects of this increased consumption is the heavy European demand. Reports have been current that Chilean nitrate was being replaced there by other nitrogenous fertilizers, but recent statistics might be used to indicate that the reverse was the case. Sales of nitrate of soda for shipment to Great Britain, Continental Europe, and Egypt in the last nitrate year amounted to 1,512,000 tons—an increase of 47 per cent over the amount sold there in the nitrate year 1926-27.

Success has been obtained in the face of severe price competition. Europe, in particular, is concerned with both the price and the efficiency of the various competitive products available for fertilizer purposes. The absorption of increasingly large amounts of natural nitrate is striking proof of the acceptance of the Chilean product and evidence that every effort is being made by European farmers to increase the agricultural yield per acre and to decrease the cost of living.

Records of the Nitrate Producers' Association show that consumption in the United States increased 55 per cent during the last nitrate year, although recent reports indicate a decline. Sales for delivery up to June 30, 1928, totaled 1,176,000 tons, as compared with 754,277 tons in the same period 1926-27. At least 70 per cent is used as fertilizer. Large amounts are absorbed in North and South Carolina, Georgia, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, and Texas in surface applications to cotton and corn, as side dressing. A quickly available nitrogenous material such as this, when applied after the plant's root system has been established, is promptly absorbed and speeds growth to maturity.

No large industry in the world possesses so many opportunities to reduce cost to the ultimate consumer and still to maintain profitable operation. The Chilean government draws its major revenue from an export tax of over $10 per ton; and the basic strength of Chilean nitrate is indicated by the fact that, despite pleas from inefficient and costly producers, it has consistently refused to lower this tax—an effective weapon held in reserve for use in the event of emergency or serious competition. This attitude is not unreasonable. The reserves are vast, but future generations must be considered, and mineral wealth is a wasting asset. The opportunities for an increased recovery of nitrate from the raw material, contemporaneous with a reduction in recovery cost, by reason of the introduction of simpler and more economical processing methods and the wider utilization of mechanical equipment and cheaper power, are such that many other avenues of economy will be investigated before reduction of the export tax is considered.

The future of the Chilean nitrate industry would seem to be bright for generations to come, whether peace or war prevails. Despite criminal conservatism in the past, it is not dead—not even dying. Events have shown that the technical inefficiency that so frequently marks the exploitation of high-grade deposits provides an available reserve of reject and lower-grade material for the next generation, to be drawn upon as scientific research and industrial vision are stimulated by economic necessity.

Studying the Action of Ball Mills

IN A GENERAL STUDY of the ball milling of zinc ores of the Tri-State district, being conducted at the Mississippi Valley experiment station of the U. S. Bureau of Mines, Rolla, Mo., a means has been adopted to find the dead load of the mill. According to the Bureau, when the dead load is subtracted from the total load during grinding, the net power—that is, the power expended within the shell of the ball mill—is the result. To obtain the dead load, a weight equal to the balls, ore and water is packed into a central position in the mill so that it revolves like a flywheel, and the required power is thus determined.

Having obtained a measure of the energy expended within the shell of the mill during working conditions, the way is clear for a scientific study of the mechanics of ball milling. Five mills ranging in diameter from 18 to 42 in. are available; they are of the tire-and-trunnion type. In commercial work the advantage gained by increasing the diameters of the mills is often under discussion. Comparative laboratory runs show that the net power varies as some function lying between the square and cube of the diameters. Refinements are being added for more precise determination of this ratio.

One mill has been arranged so that the balls may be seen in operation when working alone. To do this the solid end-plates of the mill are replaced by coarse-mesh screens. The circular paths and trajectory paths may be observed. Examination makes it obvious that the balls in the inner circular path do but little work. The critical speed when the balls cling to the circular path by centrifugal force may be definitely determined. Many other co-ordinates may be located. The arrangement will permit the taking of moving pictures.

Building a Tailing Dam in a Northern Latitude

CLIMATE is a factor in the problem of tailing disposal. The method adopted in a warm, dry region, such as the Miami district, Arizona, will necessarily be different, in details at least, from that employed by a mining company operating in a district where the winter is long and cold. After much study the Hollinger Consolidated Gold Mines, in the Porcupine district of Ontario, developed a procedure of impounding that has proved entirely satisfactory. The scheme will be described in next week's issue by Mr. A. H. Hubbell, associate editor of *E. & M. J.* Practical details of the work, illustrated with numerous drawings, will be given. Handling tailing in the calender year 1927 cost the Hollinger company only 2.29c. per ton, despite the difficulties of the task, and will probably be less in 1928.

Combined Metals Develops Dependable Steel Bulkhead Door

New Device Solves Water-Control Problem

DEPENDABLE steel bulkhead doors of new design have recently been developed and employed by the Combined Metals Reduction Company to solve a difficult water-control problem on the 400 level of the Honerine mine, at Bauer, Utah. An average of 2,500 g.p.m. is pumped from that level, and, prior to the installation of the doors, the water would rise and flood the pump motors whenever a two-hour interruption of the power supply occurred, or when pump or pipe-line trouble caused the pumps to be shut down for this period. To avoid the resultant damage to the pump motors, one of the bulkhead doors was installed between the pump chamber and the station on the level. A sketch of the installation is shown in Fig. 1.

Water can now be withheld from the pump chamber until it rises 65 ft. above the station floor. It is estimated that under present conditions the water level would not reach this height in less than six days, which period would be ample to repair any probable breakdown. The raise from the pump chamber that extends 65 ft. vertically above the station floor, and is connected with the main shaft by a drift, provides a passageway for the pump attendants and ventilation for the chamber, besides being used to bring in power cables and telephone lines. Three 12-in. pipes in the concrete underneath the door convey the water into the pump chamber. One man can close the door and the three valves in three minutes, which operations make the chamber watertight.

Another bulkhead door was installed in one of the wet drifts on the level where there was danger in the course of mining operations of encountering a watercourse, and releasing a rush of water in volume many times the capacity of the pumps, which is 4,200 g.p.m. Before blasting, while driving this drift, the bulkhead was closed. If the blast liberated a heavy flow of water, it was held back by the door, and then released in quantities that the pumping equipment could handle. Last winter, when the main haulage tunnel was not in operation, this door was closed for two months, and during this entire period it held back a 400-ft. head of water. The door is used now only when power or pump trouble occurs. It is then closed, and the flow of water in the drift held back from the station on the level until the trouble is remedied. Details of installation are shown in Fig. 2, page 826.

Concrete used was prepared in the drift. An electrically driven concrete mixer, sand, and cement were brought underground, and rock from the face was employed as aggregate for the 1:2:3 mix used. Concrete was poured continuously until the work was completed. Details of the steel door are shown in Fig. 3 (page 826). The frame had to be split into two segments to move it down the shaft. A square rubber gasket around the face of the door, which detail was taken from filter press practice, insures a watertight joint under all conditions.

Besides the installations noted at the Honerine mine, two others have been made with equal success by the Ophir Hill Consolidated Mining Company in the company's mine at Ophir Hill, Utah, where much water has been encountered. Combined Metals plans to equip several other wet drifts in the Honerine mine with the doors. The device has the following advantages: (1) It is practical and reliable; (2) no power is required to operate it; and (3) installations are not expensive.

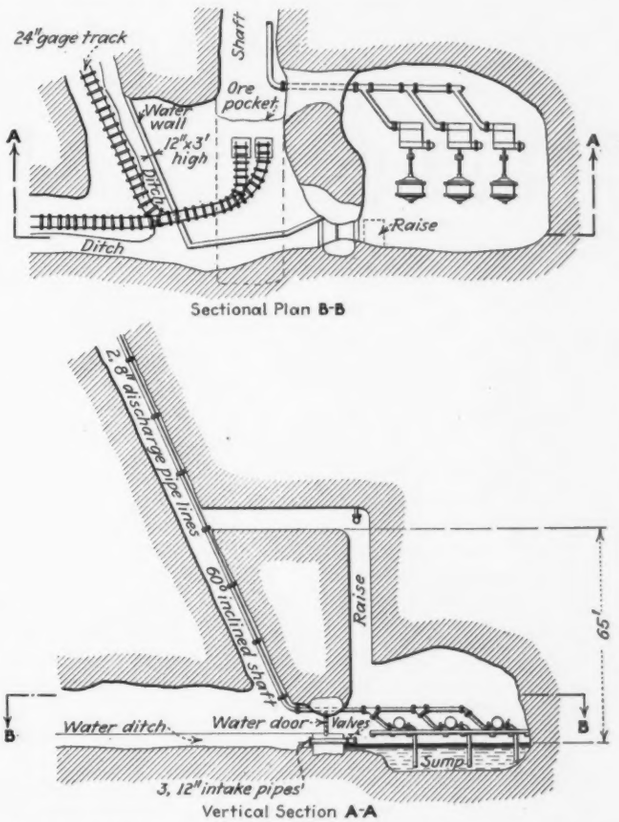
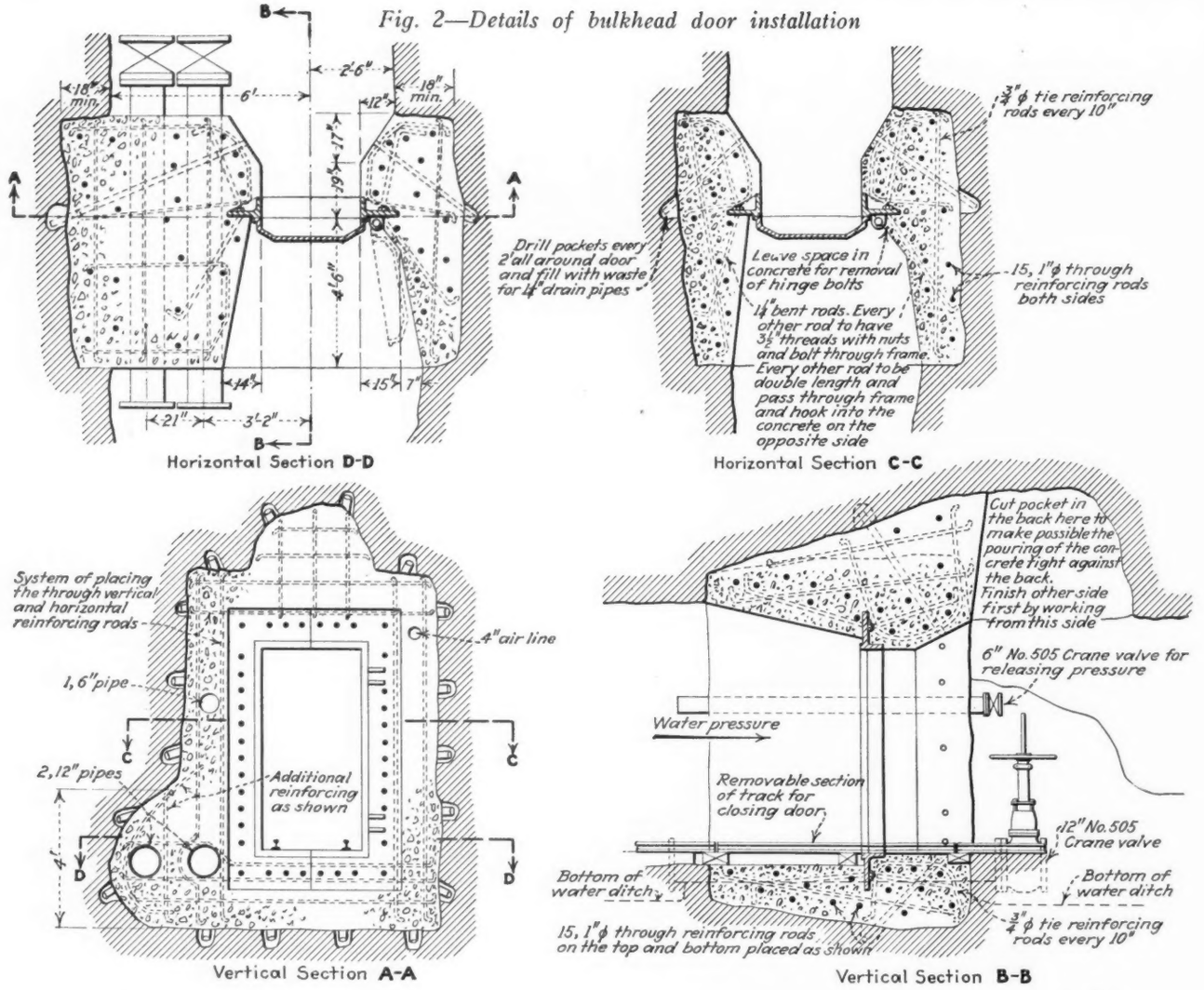


Fig. 1—Sketch showing installation of bulkhead door to protect pumps on 400-ft. level

Use of bulkhead doors at the Honerine mine was recommended by Charles E. Schwarz, chief mining engineer, National Lead Company, and by T. J. Mateer, consulting engineer. F. S. Youtsey, consulting engineer for the St. Louis Smelting & Refining Company, designed the door. The units installed were made at the Salt Lake City plant of the Eastern Iron & Metal Company. Installations at the Honerine mine were made under the supervision of W. H. Kelsey, chief engineer of the Combined Metals Reduction Company, who courteously furnished the foregoing facts and the drawings on this page and on page 826.

Fig. 2—Details of bulkhead door installation


Horizontal Section D-D
Horizontal Section C-C
Drill pockets every 2' all around door and fill with waste for 4" drain pipes
Leave space in concrete for removal of hinge bolts
1¼" bent rods. Every other rod to have 3½" threads with nuts and bolt through frame. Every other rod to be double length and pass through frame and hook into the concrete on the opposite side
¾" ϕ tie reinforcing rods every 10"
15, 1" ϕ through reinforcing rods both sides
System of placing the through vertical and horizontal reinforcing rods
4" air line
1, 6" pipe
2, 12" pipes
Additional reinforcing as shown
Vertical Section A-A
Cut pocket in the back here to make possible the pouring of the concrete tight against the back. Finish other side first by working from this side
6" No. 505 Crane valve for releasing pressure
Water pressure
Removable section of track for closing door
12" No. 505 Crane valve
Bottom of water ditch
Bottom of water ditch
¾" ϕ tie reinforcing rods every 10"
15, 1" ϕ through reinforcing rods on the top and bottom placed as shown
Vertical Section B-B

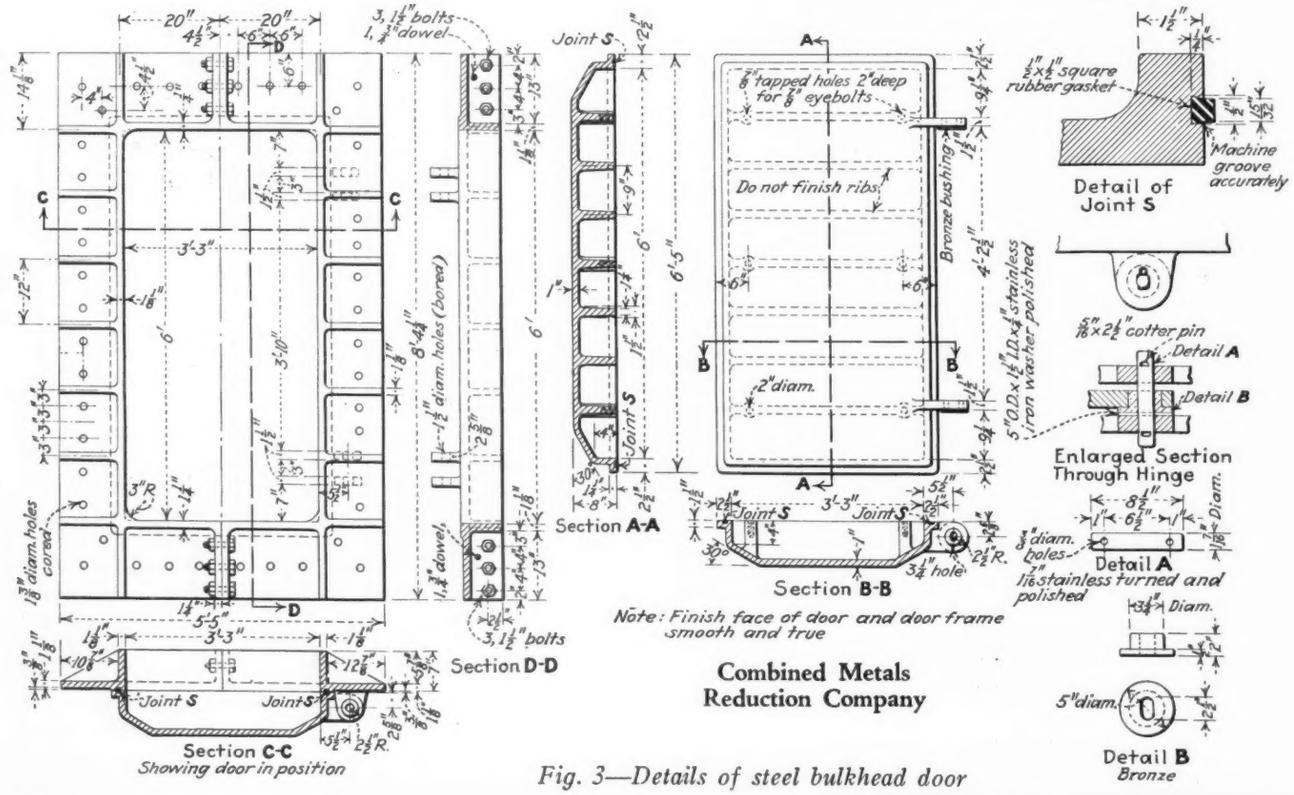


Fig. 3—Details of steel bulkhead door

The El Paso Smelter

Part XX: "Revisiting Arizona Mining Camps"

By E. H. Robie
Associate Editor

EL PASO is only a short ride of two hours from Deming, where I spent the night after visiting the Chino mill. In the city are the headquarters of the Mexican department of the American Smelting & Refining Company, but the lead and copper smelter is an entirely separate affair, two or three miles west of the city, but easily reached by street car. B. N. Rickard had just been appointed manager of the El Paso and Hayden smelters when I was there, but happened to be out of town. E. R. Marble, smelter superintendent, was about, however, and kindly showed me over the plant. As I walked through the gate to reach his office, with no objection on the part of any one to my admission, I could not but recall my first visit here in April, 1917, just at the time the United States entered the World War. Visitors, in general, were rigidly excluded, and I had to present full credentials to get inside the fence; even then, no photographs were permitted to be taken. While I was visiting with James Heggie, who was superintendent there at that time, another visitor appeared who affirmed that he was an important A. S. & R. stockholder and a friend of several of the New York officials. He wished to see the plant, but he had no success; he had a German accent and appearance, which was looked on with great suspicion in those days. I later met the same gentleman in Globe, and often wondered afterward if he were merely a curious sightseer or actually a spy trying to find out what he could about the metal-production facilities of our country.

Improvements have been made from time to time in the lead department of the El Paso smelter, but it has not yet been revamped to the extent that Mr. Marble would like. The sampling plant is perhaps the next part of the works to be remodeled. When I was there, the lead-bearing ores and concentrates received amounted to about 400 tons a day, much of this coming from Mexico, particularly from the Ahumada property. Until recently, this was the only lead smelter in that part of the country, but competition is now afforded by the Phelps Dodge furnace at Douglas.

Ore and concentrates received are bedded in bins. A double sintering is performed in Dwight & Lloyd machines, followed by the usual blast-furnace smelting, with shipment of the bullion to Omaha or Perth Amboy for refining. The charge to the first D. & L. contains about 11½ per cent sulphur, which is reduced to 6½. A new crushing plant for this sinter was being installed last spring, using first a toothed roll, followed by a smooth roll set to ¼ in. In the second-over product, the sulphur is brought down to about 1.8 per cent.

The blast-furnace slag was being run with an 11 per cent zinc content, the percentage of copper on the charge being 3.2 per cent. With less copper, a higher percentage of zinc can be taken care of, East Helena, I believe, carrying about 14 per cent of zinc in the slag, with about 1½ per cent of copper in the charge. With over 3 per cent copper at El Paso it is impossible to keep open lead wells, as too much dross forms. The matte contains about 9½ per cent zinc.

The Copper Department

The El Paso copper smelter functions chiefly to smelt the Chino concentrate, though some direct-smelting ore is also received. The last-named is crushed to ¼ in. with a gyratory, a Symons disk, and rolls.

The roasting equipment consists of eight old five-hearth Wedge furnaces and four modern seven-hearth Wedges. Three of the old type furnaces have been revamped with air cooling of the arms, thus doubling their capacity to about 100 tons per day and permitting oil consumption to be reduced. The seven-hearth furnaces roast about 165 tons a day, with an elimination of about seven units of sulphur, of which there is 24 per cent in the charge. For fuel, 2½ gal. of oil per ton is commonly required. In addition to the strictly copper ores and concentrates roasted, about 5 per cent of the charge is composed of zinc-retort residues from the Amarillo plant, containing about 2.4 per cent lead; 1.5, copper; 7, zinc; 4, sulphur; 15, silica; 16, iron; 3, lime; 4, alumina; and 39 per cent fixed carbon. In my notes made at the time of my visit I find the surprising statement that this residue will not burn until it is heated to the ignition temperature, meaning, I presume, that the 39 per cent of fixed carbon does not make for spontaneous combustion! A part of this residue, incidentally, goes to the lead department, in the effort to get rid of it, and a part is used to burn in the converters to keep them hot when they are not converting matte. I fancy its disposal is a problem for the bookkeeper as well as for the metallurgist.

One large reverberatory furnace was in use, its dimensions being 130 ft. 6 in. by 28 ft. 4 in. As much as 1,100 tons a day has been put through this furnace, even then the converters being the limiting factor, but the available charge was only 500 tons a day last spring. This did not make for a particularly good fuel ratio, which was about 0.6 bbl. of oil per ton, though as low as 0.35 bbl. was secured when the maximum tonnage was being smelted. Center charging is practiced, as at the other A. S. & R. smelters, with five drop holes used instead of four, as I explained for the Hayden furnace, the fifth hole being in the center of the arch a little further from the bridge wall than the adjoining set of two holes. The furnace is charged about five times an hour, calcine usually being admitted through three of the five holes during the charging operation. At that time, the burners are turned off. For best results, the temperature of the calcine must be carefully regulated, either a too-hot or a too-cold condition making for inefficiency. Also, it is not thought practicable to combine center and side charging, from purely the metallurgical standpoint. The matte bath is 7 or 8

ft. deep immediately under the charge holes of the furnace.

The side walls of the furnace are constructed partly of magnesite brick and partly of silica brick. They are cooled by water jackets on the outside. The arch is made of 20-in. silica brick, and repairs, when necessary, extend for a distance of from 15 to 35 ft. from the bridge wall. The draft is maintained at about 0.2 in. Matte averages about 36 per cent copper, and, with a good charge, the following is a representative slag assay: Copper, 0.39 per cent; silica, 37; ferrous oxide, 46; lime, 5; and alumina, 5 per cent.

As the El Paso smelter is situated in a settled community, there is, of course, a smoke problem. Though one would not consider the surrounding country especially suitable for farming, I understand that some cotton is raised and that the farmers have not been convinced of the value of smelter byproducts as fertilizers and insecticides. Oil burners are installed in the base of the stacks from both the lead and copper departments; and, when conditions are unfavorable, the temperature may be raised to 350 deg. F. in the copper stack, and to 250 deg. in the lead stack.

It is expected that early in 1930 another important metallurgical enterprise will be in operation in El Paso—the electrolytic copper refinery of the Nichols Copper Company. For some time uncertainty existed as to whether the series or multiple system would be used in this plant, but the multiple system has now been decided upon, and plant construction will begin soon.

My short stay in El Paso brought to an end the field trip which has been the topic of the twenty articles, of which this forms the last, and permitted me to embark on one of the palatial transcontinental trains that still put one off at Chicago for some reason, instead of running through to New York. Riding on the train reminded me of the prophetic words of Anatole France, written twenty years ago, when in "Penguin Island," he said: "Then he took the great railway that led to Gigantopolis, the capital of New Atlantis. In the train there were restaurants, gaming rooms, athletic arenas, telegraphic, commercial, and financial offices, a Protestant Church, and the printing office of a great newspaper. . . . The train passed along the banks of great rivers, through manufacturing cities which concealed the sky with the smoke from their chimneys, towns black in the day, towns red at night, full of noise by day and full of noise also by night."

May I take this opportunity of acknowledging publicly the kindly hospitality with which I was everywhere received in the Southwest. At no plant was I barred, nor has anything which I have written, all of which was submitted before publication to interested company officials, been unduly censored. Rather, have I been the recipient of much helpful data in expanding my notes. This spirit of co-operation for the good of the industry, so generally exhibited at the mining and metallurgical plants of the United States with the exception of those of one important company whose chief official has not yet learned its wisdom, is a leading reason why American practice has advanced so markedly.

When one stays only a few hours in a place, it is impossible to gather sufficient background and data to prepare an article that is properly descriptive of what is being done. I have presented these notes, therefore, for what they are; merely the highlights of practice as I have run across them, with enough supplementary detail to make a connected story. Inquiries from those with special interest will, I am sure, be answered in as helpful a manner as possible by local operating officials, many of whom will, also, be represented from time to time as the authors of more worth-while articles in these pages. By so doing they can supplement the open door that they maintain at their plants, co-operating with their friends in the fraternity and all unconsciously achieving for themselves a measure of distinction and credit for work well done.

Recovery of Molybdenum Waste in Treatment of Oxidized Lead Ores

UNDER existing conditions in the treatment of oxidized lead ores containing small quantities of molybdenum no provision is made for the recovery of the molybdenum, the U. S. Bureau of Mines points out. Considerable quantities of this important element are lost in the slags of the lead smelters and constitute an economic waste. Slag dumps containing molybdenum in small quantities probably could not be economically treated for the recovery of the element, but steps for the prevention of waste in this respect can be taken prior to smelter treatment.

Wulfenite, lead molybdate, and molybdite, are the molybdenum minerals most abundantly found in deposits of oxidized lead ores. Plumbojarosite, argentojarosite, cerussite, and occasionally anglesite are commonly associated with wulfenite ores. Oxidized iron content is usually fairly high.

The recent discovery and development of a body of wulfenite ore in the Star district near Milford, Utah, led to a cursory microscopic examination of samples of the ore, by members of the staff at the Intermountain Experiment Station of the Bureau, followed by a few preliminary tests for the separation and recovery of the lead and molybdenum in separate products.

Samples used in the work were composed of wulfenite, plumbojarosite, and a small quantity of cerussite. Iron content was quite high. The physical character of the ore suggested that it could be successfully treated by the chloride volatilization method for the removal of lead from the plumbojarosite and molybdenite and that the resulting calcine would contain the molybdenum in the oxidized condition. Furthermore, it appeared feasible to treat the calcine containing molybdenum and iron in an attempt to form ferromolybdenum. The results of the Bureau's experiments indicate that the treatment mentioned can be applied to ores of the type under consideration and that the waste of molybdenum may thereby be prevented. The commercial application of the method depends on local conditions and other factors.

Chloride volatilization is advisable when it is desired to remove both silver and lead from ferruginous ores containing molybdenum. Oxide volatilization, however, may be the better treatment when it is desired only to remove lead. The latter method would leave nearly all the silver in the residue, which could subsequently be sent to the smelter. In volatilizing lead as the oxide, a reducing agent, as coal, may be added; if it be desired to carry the reduction to the point where metallic iron is formed, this may be done either simultaneously or later by the use of more intensely reducing conditions.

Details of these tests are given in Serial 2,888, "Molybdenum Waste in Oxidized Lead Ore Treatment," by R. E. Head and Virgil Miller, copies of which may be obtained from the U. S. Bureau of Mines, Washington, D. C.

SAFETY *From the Viewpoint of Management*

By R. M. ROOSEVELT
Vice-President, Eagle-Picher Lead Company, New York

THERE are many different ideas of what management is, but management to me is something like a tree. It has roots and a trunk, branches, leaves, and sometimes it bears fruit if the roots and the trunk and the branches and the leaves all work together. All trees have to start from the roots. The roots of industry are its workmen.

Soon after I graduated from college I went to work. The third day, I think it was, I came back from lunch and saw a man being pulled out of a tank car. His face was gone clear to the bone. They laid him out on the dock. I took the pulse to see if he were alive, and found it beating. They sent for a doctor. I still held the pulse, but soon it ceased to beat. They had missed the man at noon and started a search. He had been sent into a tank car containing sludge acid in the bottom, to clean it out, and had evidently fallen forward. I suppose they buried him. I suppose the insurance company paid the bill. It wasn't on our cost sheet, anyway. I could do nothing, having no voice in the management.

Later I became foreman in another plant, and there had an opportunity to stop accidents. We had a roasting department where hot ore was taken out of the cars, which were placed on little elevators and hoisted 15 or 20 ft. into the air. The cars were pushed over the top of bins, into which the ore was dumped. I stood near that elevator one day and saw three men hurt in about fifteen seconds. At that time I did not know what to do, but I decided that it was because the men did not think for themselves. I began to educate them. We cleaned house. I went as far as I could as foreman, but I did not stop accidents. I stopped some of the foolish ones, perhaps, but more continued to occur.

Every accident delayed operations. I felt that if I became superintendent some day I would correct many practices that I could not correct as foreman. In due time I became a superintendent and helped my foremen reduce accidents; but I found that they never realized how much the accidents were costing. After an accident the foreman would put another man on the job, and the insurance company would talk to the man who was hurt. The foreman never came in contact with the cost. He never knew if the insurance company paid $100 or $1,000. So I made arrangements with the insurance company that we would settle our own claims fairly—to the insurance company and the men. I had found out that of the money we paid the insurance company at that time, only 22c. out of every dollar found its way to the workman who was hurt. The remainder went to the attorneys, for overhead, to the claim agent, and to others. We kept the claim agent out of it, and the foreman and myself decided what we were to pay. Thus did we realize that accidents were paid for by somebody, in cash.

But men were still being hurt. To a query came the reply, "Well, you don't think the men are getting hurt for fun? It hurts them to stay in the hospital a darn sight more than it hurts you, as superintendent, to have them hurt." And I could not answer that argument. Later I became manager of a plant, and carried my own insurance, which brought the cost of accidents home to us. If a man was hurt we put him on the pay roll for half time or full time, and the cost came out of the profits. If there were no profits we had to cut wages or do something else. That brought the cost of accidents home to the workman, to the foreman, and to the superintendent. Then a personnel man was appointed, and a study showed that a workman who had bad teeth, for instance, and was in poor condition physically, was more likely to be hurt than one whose teeth were sound. We finally put in a physical examination to start with, and when we found a man who had bad teeth we sent him to a dentist. We did all we could to help the man retain his mental alertness. Also, a good worker cannot have family worries or bills to pay; he must be in good physical condition and he must have pride in the place in which he works, and confidence in the company.

In 1925 the cost of accidents had been reduced to about $12 per man yer year, but we found that even that could be improved. Men were appointed on committees. Signboards were provided with disks for each department—green disks if they had no accidents and red disks if they had. In 1926 the accident cost per man per year was reduced to $2.69; in 1927 to $2.24.

When I was foreman we averaged nearly two hours lost out of a day. Today the man in charge of that same department is allowed only 1½ hours per month lost time. He gets a bonus of so much a minute for every minute less than 1½ hours that the delays cost that department. The workman has not changed; he has no more education. We haven't hired better men. The management has improved. It has taken the same man and educated him so that he can avoid accidents.

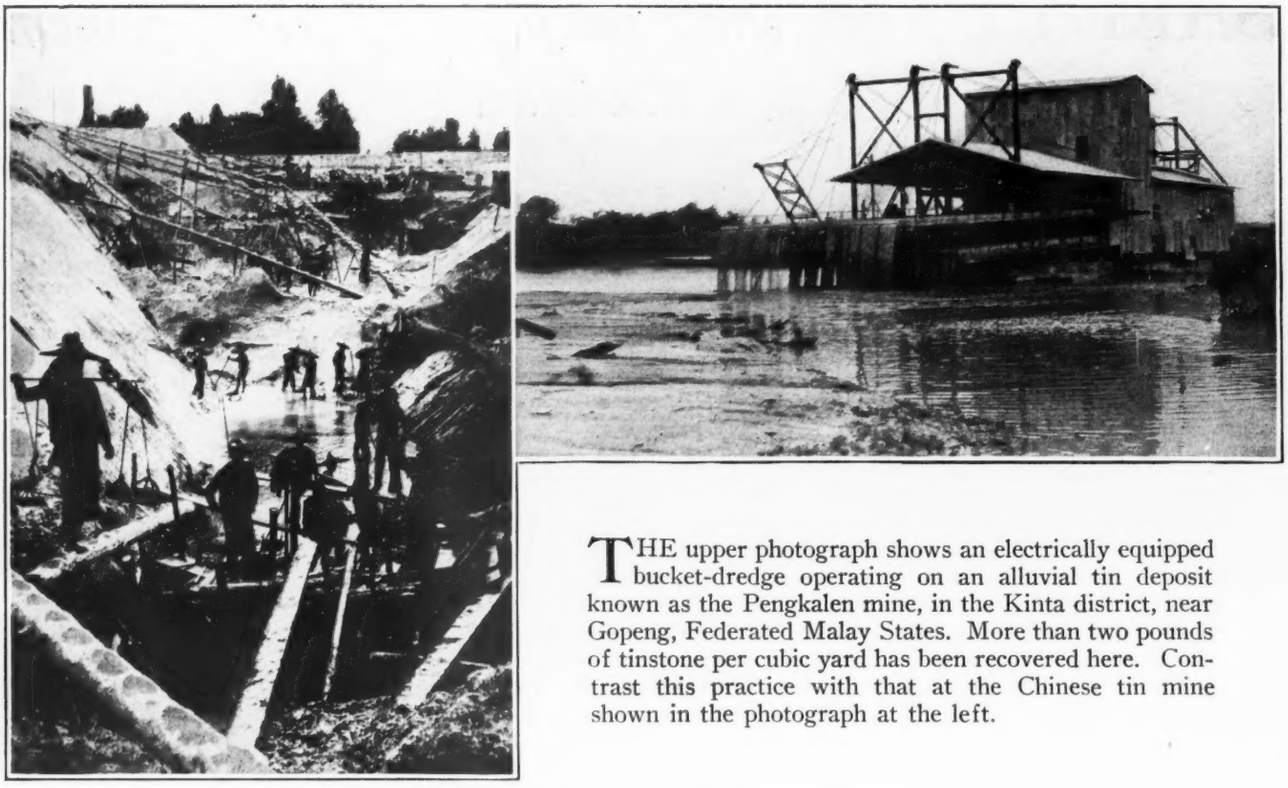
The records in some plants are good, but in others they are bad. I was told recently of a survey in a certain district in the United States where 50 to 52 per cent of the workmen employed had lung trouble. While in your own plant you may be helping a few hundred or a thousand workmen to avoid accidents, you are also helping maybe 50,000 men outside your plant by the example you set and the notice you attract to the safety-first movement.

RALPH M. ROOSEVELT

MR. ROOSEVELT, in addition to being vice-president of the Eagle-Picher Lead Company, in charge of the New York office, is president of the American Zinc Institute. Three or four generations ago he, with Franklin Roosevelt, Governor-Elect of New York State, shared the same grandfather with Theodore Roosevelt. He comes from a long line of engineers, and was himself graduated from the mechanical engineering college of the University of Michigan. Since then, "Pete," as he is familiarly known, has been building and operating zinc-smelting plants, being connected with that at Hillsboro, Ill., since its inception. Those who know the human qualities of Mr. Roosevelt are not surprised at his success in welfare work; it is exactly what they would expect.

Abstract from an address given before the National Safety Council, at New York, recently.

Tin Mining in the Far East



THE upper photograph shows an electrically equipped bucket-dredge operating on an alluvial tin deposit known as the Pengkalen mine, in the Kinta district, near Gopeng, Federated Malay States. More than two pounds of tinstone per cubic yard has been recovered here. Contrast this practice with that at the Chinese tin mine shown in the photograph at the left.

Amount of Scrap Metal Recovered Gained Only Slightly in 1927

THE value of certain non-ferrous metals recovered from secondary sources in 1927 is reported to the U. S. Bureau of Mines as $256,352,000, which is $18,188,900 less than in 1926. This decrease in total value, according to J. P. Dunlop, who compiled the figures, was due to a lower yearly average price for all the metals reported except nickel. Total recoveries were about 11,000 tons more than in 1926. Small increases were recorded in the recoveries of copper, brass, aluminum, nickel, and tin, and small decreases in lead and zinc. Antimony decreased 24 per cent, although primary antimonial lead, made at regular smelters, increased nearly 1,850 tons. Smelters that treat ore primarily recovered 104,934 tons of copper from scrap, which was 7,600 tons less than in 1926.

The most significant feature of the copper industry was the large increase in the quantities of scrap copper and brass exported. Combined shipments of copper and brass scrap increased from 34,845 tons in 1926 to 68,706 tons in 1927.

All of the increase in secondary lead was in alloys. Recoveries as pig lead decreased 6,000 tons.

Zinc recovered by redistillation increased nearly 2,000 tons. Zinc recovered by sweating and remelting declined about 1,750 tons. Less zinc dross was exported, but the quantity of dross and skimmings used for lithopone and zinc chloride increased in 1927. Exports of zinc dross decreased about 6,000 tons, reflecting, in part, the larger recovery by redistillation at domestic retort zinc smelters.

Secondary tin recovered as metal decreased 950 tons. Less tin was consumed in making tin plate, so that the recoveries from tin dross and scruff treated were less. A large increase in tin recovered in alloys such as bronze and babbitt is to be recorded, and the detinning plants treated an increased quantity of tin-plate clippings and old tin-coated containers. Most of this recovery by detinners was marketed in chemical compounds, which increased from 4,317 tons in 1926 to 4,941 tons in 1927. The quantity of secondary nickel recovered as metal and in non-ferrous alloys increased 11 per cent. The trend toward consolidation of plants and better technical methods notable in 1926 continued during 1927.

Secondary Metals of Certain Classes Recovered in the United States, 1926-27

	1926		1927	
	Short tons	Value	Short Tons	Value
Copper, including alloys other than brass	281,700	$78,876,000	290,000	$75,980,000
Brass scrap remelted	283,000	65,918,000	286,000	60,516,400
Lead as metal	125,000	44,368,000	119,000	34,776,000
Lead in alloys	152,300		157,000	
Zinc as metal	64,570	11,600,000	64,800	9,881,600
Zinc in alloys other than brass	13,430		12,400	
Tin as metal	9,750	42,511,500	8,800	46,302,100
Tin in alloys and chemical compounds	23,650		28,100	
Antimony as metal	2,910	3,164,400	1,700	3,060,300
Antimony in alloys	13,320		10,700	
Aluminum as metal	20,500	23,868,000	23,000	23,469,600
Aluminum in alloys	23,700		23,200	
Nickel as metal	485	2,135,000	480	2,366,000
Nickel in nonferrous alloys and salts	2,565		2,900	
Totals	.....	$274,540,900	.....	$256,352,000

Additional data on secondary copper, lead, aluminum, zinc, tin, and nickel are given in the complete report, obtainable from the U. S. Bureau of Mines.

Personal Notes

CHARLES BOCKING, general manager of Granby Consolidated, has returned to Vancouver after a visit in New York.

FREDERICK MACCOY visited San Francisco recently before returning to Mexico City.

WALTER W. BRADLEY, state mineralogist of California, married Miss E. Bradshaw on Nov. 11, 1928, at Tacoma, Wash.

F. W. REILLY, of Sherman & Reilly, consulting engineers, Chattanooga, Tenn., is in Oklahoma on professional business.

DONALD MACASKILL, superintendent of the International Nickel Company's smelter at Copper Cliff, Ont., was in New York for a few days this week.

HUGH M. HENTON, formerly assistant professor of metallurgy and mining at Washington State College, is now associate professor of metallurgy at the Alaska School of Mines.

A. F. TAGGART, professor of ore dressing at Columbia University, New York, was recently in San Francisco as a witness in the flotation litigation before the Appellate Court.

E. E. WHITELY, assistant manager of Calumet & Arizona Mining, and M. S. LINDHOLM, geologist of the company, recently examined some mining property near Barstow, Calif.

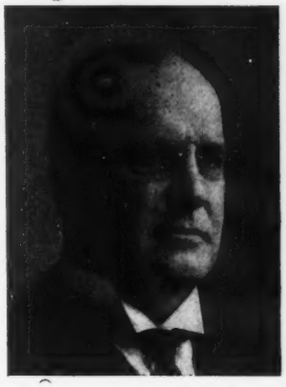
B. DUNSTAN, chief government geologist of Queensland, Australia, left Brisbane recently for Germany to investigate geophysical methods and modern practice in treating zinc ores. He expects to be abroad for six months.

RUFUS M. BAGG, geologist, of Appleton, Wis., will leave for South America in the near future. He also intends to attend the International Geological Congress at Pretoria, South Africa.

E. J. COLLINS, vice-president of Calumet & Arizona Mining, is making his annual trip of inspection to the company's property at Bisbee and to its subsidiaries, the New Cornelia mine, at Ajo, and the Verde Central at Jerome, Ariz.

E. W. ROUSE, JR., has been transferred from the position of general superintendent of the Baltimore Copper Smelting & Rolling Company to that of manager of the Perth Amboy plant of the American Smelting & Refining Company, Maurer, N. J.

FREDERICK W. HORTON has been employed by the Bureau of Mines as mineral economist and will make a study of the mica reserves of the United States, particularly as they involve the interests of the War and Navy departments. Mr. Horton has begun his work in New England. Ultimately it will extend to all states where mica occurs.



SIDNEY J. JENNINGS

CHARLES L. BURDICK announces that he has severed his connection with Guggenheim Brothers, resigned as vice-president and consulting engineer of Anglo-Chilean Consolidated Nitrate Corporation, and will join the staff of Lazote, Inc., as director of development. A brilliant academic career laid the foundation for Doctor Burdick's investigations on the scope for the application of the Phase Rule in the solution of the technical problems of the Chilean nitrate-mining industry. Subsequent to graduation from Drake University in 1911 he continued studies and research and obtained degrees from many institutions, including Massachusetts Institute of Technology, University of Basel, Switzerland, University of Berlin, Kaiser Wilhelm Institute, Berlin, and University College, London.

OBITUARY

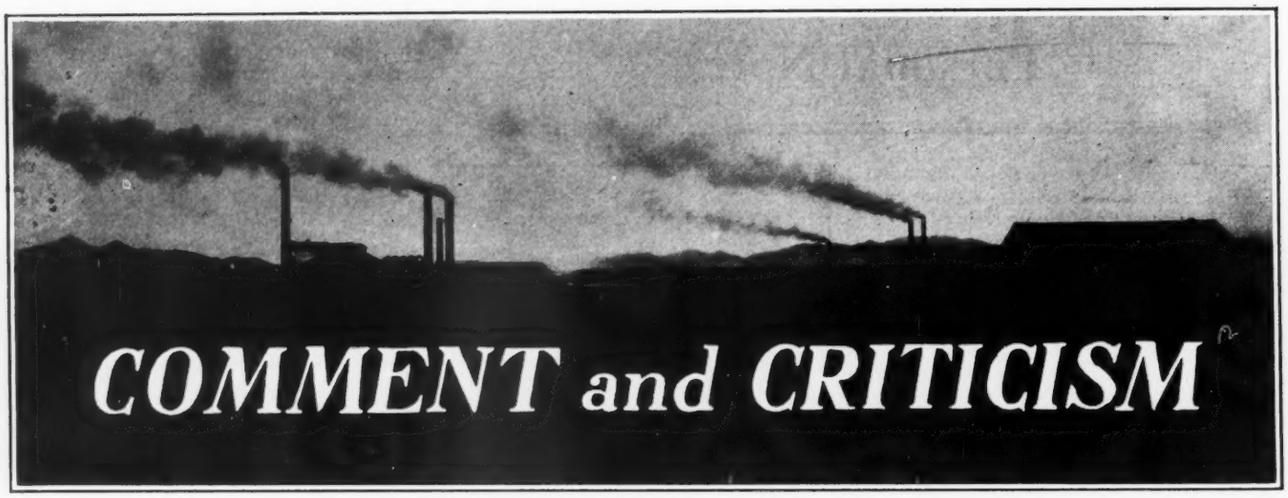
ERNEST C. MENDENHALL, mining man, of Lake City, Colo., was killed on Nov. 12 when the horse on which he was riding stepped on a piece of dynamite. He was 53 years old.

CHARLES M. HENROTIN, mining engineer, was one of the victims of the "Vestris" disaster. His body was recovered, and identified by his brother, Morris Henrotin, a New York banker. Mr. Henrotin was 50 years old, and several years ago was engaged in work in northern Ontario, for a time with the Canadian Copper Company at Copper Cliff. Recently he has maintained headquarters at Georgetown, British Guiana.

THOMAS CHROWDER CHAMBERLIN, emeritus professor of geology at Chicago University, died in Chicago on Nov. 15. Professor Chamberlin was a native of Mattoon, Ill., being born there on Sept. 25, 1843. He was head of the department of geology and the Walker Museum at Chicago University from 1892 to 1919, and was also, for a time, geologist of the State of Wisconsin. He was the author of a number of geological works, the best known probably being "The Origin of the Earth," published in 1916.

FREDERICK KENT COPELAND, president of the Sullivan Machinery Company since 1892, died at Claremont, N. H., on Nov. 10, while on a visit to the company's Eastern works. He was born in Lexington, Mass., and was a graduate of Massachusetts Institute of Technology in 1876. After several years spent in practicing mining engineering in Colorado, he helped organize the Diamond Prospecting Company in 1884, becoming its president. This company engaged in contracting with diamond core drills made at Claremont by the Sullivan Machinery Company. In 1892 the two companies were merged, with Mr. Copeland as president. Under his leadership, Sullivan products were developed for a wide range of purposes, manufactured at plants at Claremont and at Michigan City, Ind., and a world-wide sales organization was built up. Mr. Copeland was a member of several engineering societies, including the A.I.M.E., and was a former president of the Engineers' Club of Chicago, of the Western Society of Engineers and of the National Metal Trades Association. He had served as trustee of the Massachusetts Institute of Technology and, in earlier years, as a trustee on the village board of Winnetka, Ill., where he made his home for nearly 40 years.

SIDNEY JOHNSTON JENNINGS, mining engineer and vice-president of U. S. Smelting Refining & Mining, died in New York City on Nov. 17 at the age of 65. He was born at Hawkesville, Ky., on Aug. 13, 1863. His early education was obtained in France and Germany, and he was graduated from Harvard University, in 1885, with a degree in civil engineering. He was a surveyor for New Almaden Quicksilver, in California, and suveyor and engineer for Anaconda Mining, before leaving, in 1889, for South Africa as manager of the Willows Copper Argentiferous Syndicate. After his resignation from the last-named company he was appointed assistant manager of DeBeers Consolidated. In 1893 he left Kimberley and worked for fourteen years on the Rand, eventually becoming consulting engineer for H. Eckstein & Company, which then controlled 40 per cent of the Rand output. On returning to the United States in 1907, he set up practice as a consulting engineer, becoming vice-president in charge of exploration for U. S. Smelting Refining & Mining. He was also, at the time of his death, a director in Real del Monte y Pachuca and Hanover Bessemer Iron & Copper. Mr. Jennings was president of the A.I.M.E. in 1918-19 and of the American Mining Congress, at whose annual meeting he was scheduled to speak this year, in 1922-23. An editorial appreciation will be found on page 815.



COMMENT and CRITICISM

Refractory Patio Tailing Responds to Leaching

Solution of Difficult Hydrometallurgical Problem Effected By a Modification of Hyposulphite Process

To the Editor of "E.&M.J.":

The Blaisdell Coscotitlan Syndicate, of Pachuca, State of Hidalgo, Mexico, has beneficiated more than 1,000,000 tons of old patio tailing. About 75 per cent of this was treated by a modification of the Russell process, the novelty of which is the use of metallic copper as the precipitant, commercial sodium hyposulphite being added to the top of the leaching charge. The result is a solvent of cuprous-sodium hyposulphite, employed throughout the cycle of treatment.

Several metallurgists have asked me to release the details of operations at Pachuca, but I have refrained from so doing because I have felt that the scheme at Pachuca possessed only an academic interest; that it was virtually "dead" commercially. Now I am not so sure but that the method may deserve some consideration in approaching the treatment in general of old and oxidized tailing, particularly if mercury is one of the constituents.

More than 1,500,000 tons of patio tailing has been treated by this method in Mexico at a profit, and more is available.

The idea of using metallic copper as precipitant, instead of adding copper sulphate to a sodium hyposulphite solution, must be credited to Albert Delissalde, a French metallurgist. The process was patented in Mexico, but not, I believe, elsewhere. I have the impression that the Mexican patent expires in 1929. At Pachuca we paid a royalty of 10c. per ton to Mr. Delissalde, except during the low silver market of 1914 and 1915, when he generously released us from royalty obligation.

The Russell process calls for several washes of sodium hyposulphite and a final wash or two washes of sodium hyposulphite to which copper sulphate has been added. The precipitant is sodium sulphide. Sodium hyposulphite is regenerated. The Delissalde process employs a cuprous-sodium hyposulphite solvent throughout the cycle of treatment, the copper member being maintained by precipitating the pregnant solution on metallic copper. The strength of the sodium hyposulphite depends on the quantity added to the surface of each new vat of tailing.

In one series of cuprous-sodium hyposulphite salts the molecules of the sodium member occur in geometrical progression—Lenz salt, $3Cu_2S_2O_3.2Na_2S_2O_3.5H_2O$; standard extra salt (Russell salt), $3Cu_2S_2O_3.4Na_2S_2O_3.5H_2O$; extra salt, $3Cu_2S_2O_3.8Na_2S_2O_3.5H_2O$; 50 per cent extra salt, $3Cu_2S_2O_3.16Na_2S_2O_3.5H_2O$; 25 per cent extra salt, $3Cu_2S_2O_3.32Na_2S_2O_3.5H_2O$; and so on.

Lenz salt results from the combination of copper sulphate and sodium hyposulphite in a water solution, as follows: $6CuSO_4.5H_2O + 11Na_2S_2O_3.5H_2O = 3Cu_2S_2O_3.2Na_2S_2O_3.5H_2O + 6Na_2SO_4 + 3Na_2S_4O_6$. The remainder of the series forms in a similar way, except that, instead of 11 molecules of sodium hyposulphite, 13, 17, 25, 41, respectively, are required. Lenz salt precipitates from its water solution. The other salts do not, although decomposition is rapid in the case of the standard extra salt and becomes less likely to occur as the salts increase in the sodium member. Copper chloride also forms these salts with sodium hyposulphite and involves no loss of sodium hyposulphite such as characterizes the use of copper sulphate. Calcium hyposulphite may be substituted for the sodium salt and can be produced locally.

The standard extra or Russell salt decomposes quickly; hence its usefulness is limited to final washes after the straight hyposulphite leach. Manifestly, this salt in solution is not adaptable as a metallurgical solvent for continuous leaching.

The extra salt in a water solution will endure for several days before breaking down. As a lixiviant brought into repeated contact with leaching tailing, reactions with constituents of the charge result, and, together with the oxidizing effect of the atmosphere, alter it to another salt of the series proportionally lower in the copper member —to the 50 per cent or even the 25 per cent extra salt. The 25 per cent extra salt may develop from an original extra salt, or by a two-stage reaction from an original 50 per cent extra salt.

Although the first two salts of the series may not be available in practice as the sole solvent in any continuous leaching operation, the 50 per cent extra salt, under the proper conditions, can be built up in a solution and can be maintained as this salt under adverse conditions such as strong sunlight, evaporation, long cycle of treatment, slow percolation, and highly oxidized and contaminated tailing. This is the particular salt that had an important part in the Delissalde process as used by us at Pachuca, and as therein built up provides the principal novelty in our method of treatment.

All the chemical combinations of gold, silver, and mercury likely to be present in patio tailing deposits are subject to dissolution in a water solution of the so-called Delissalde salt. They combine with cuprous-sodium hyposulphite through replacement with copper or sodium to make corresponding metal-sodium hyposulphite. Contacting this pregnant solution with granulated copper, these three metals are precipitated in the metallic form and replaced in the double salt by copper; hence, the solvent of cuprous-sodium hyposulphite.

The sodium member dissolves the oxidized salts, and the dissolution of sulphides depends upon the copper member of the double solvent salt. Mercury, even when not present as a sulphide, re-

quires copper hyposulphite for complete dissolution. Metallic salts and minerals amenable to simple sodium hyposulphite react a trifle slower to the Delissalde double salt than to simple sodium hyposulphite. Sulphides and sulpho-salts, which depend entirely and solely upon the copper member of the solvent for dissolution, dissolve slower than the oxidized salts; consequently such salts determine the economic length of time for a cycle of treatment.

The particular appeal of the possibilities of the Delissalde process at present is in treating mercury-bearing tailing. Recovery of a kilogram of mercury per ton of tailing leaves $2.60 net to a shipper today in Mexico. A kilogram and over of mercury content in a ton of patio tailing is not unusual on considerable tonnage, though 600 grams of mercury per metric ton reflects the content of a greater tonnage. Two losses of mercury occurred in the patio process—one a mechanical loss of metallic mercury and some amalgam which did not extend in deposition beyond the immediate vicinity of the patio itself; and the other loss entirely chemical, because of the particular reactions characteristic of the patio process. It is this latter loss that accounts for most of the mercury, if not all, today existent in accumulations of patio tailing. Neither metallic mercury nor amalgam has been observed in the tailing at Pachuca. Chemical investigation, moreover, has demonstrated that certainly over 95 per cent of the mercury is not present as metallic mercury or amalgam.

A simple "trough" experiment—letting a sodium hyposulphite-tailing pulp flow down a launder about 15 ft. long for four to five seconds—will put 45 to 50 per cent of the mercury into solution. A few days' leach with the usual stock Delissalde solution at Pachuca dissolves 95 per cent readily, and often a little more. One naturally suspects mercurous chloride—calomel—and we had very good reason to believe that about half of the mercury was present as this salt. Conceivably, a small amount of the water-soluble chloride of mercury might have been present. The mercurous and mercuric chlorides are recoverable with an alkaline hyposulphite, but the double copper salt is necessary to dissolve in any reasonable period of time as much as 50 per cent of the total mercury content. I do not know what form of mercury depends solely upon the copper member of the cuprous-sodium salt of hyposulphite for dissolution, but it is not sulphide, metallic mercury, or amalgam. Perhaps I should not be so positive about the sulphide, yet we have had mercuric sulphide in contact with the plant stock solution for months without appreciable loss in weight.

In leaching tests in the laboratory, 95 per cent and more of the mercury is dissolved. In practice, the extraction ranges from 75 to 90 per cent, but here we have to do with rather poor physical conditions for a good contact between the solvent and the tailing. A few vats of relatively more sandy tailing have checked with our best results in the laboratory as to extraction of mercury, as well as of gold and silver.

The mercury precipitates on the metallic copper by a simple interchange of copper and mercury. The precipitate is black, but a simple friction of the precipitate in the palm of the hand is sufficient to produce globules of amalgam of gold, silver, and mercury. These precipitates are periodically washed off the copper, collected in a sump, and pumped into a plate filter-press. The corresponding cake, without moisture, contains 50 per cent mercury. The moist cake is molded into forms somewhat larger than common brick, and retorted without addition of iron or lime—evidence again that mercuric sulphide is not involved.

Were this process sufficiently interesting in general, I would gladly enter into full details of our operations at Pachuca and experience with other tailing. As it is, these notes should enable one to test it on tailing, dumps, and other material of that nature. In a laboratory investigation, a stock solution should be built up on the material that is to be tested. A few pounds can be leached with 0.5 per cent sodium hyposulphite, and the pregnant solution precipitated on fine copper wire closely packed, as in zinc-shaving precipitation practice. The solution thus developed could then be tried in actual tests. In making a test, the charge should be under solution on top, or precipitation will occur on the moist exposed surface. So, also, should the copper precipitant be kept under solution, or oxidation may take place and metals be redissolved. Acidity decomposes hyposulphite, and lime-alkalinity retards the dissolution of silver. Therefore, keep the solution neutral.

The process has the unfortunate disadvantage that it is limited to leaching. At Pachuca we experimented with agitation in the open and also under vacuum. In the air about 45 per cent of the gold, silver, and mercury went into solution in a few minutes with a Delissalde solution; further agitation produced nothing but oxidation of copper and sodium hyposulphite. This same extraction resulted from agitation with simple sodium hyposulphite, indicating that the copper member is without effect in agitation.

At Pachuca we had tailing that percolated nicely in beds up to 6 ft. deep, as well as very fine material that would hardly percolate at all through 18 in. or less. The sandy tailing was worked up by cyanidation. The Delissalde process was introduced only when cyanide consumption became prohibitive, and the tailing left was far from being physically suitable for percolation. Nevertheless, 750,000 tons was leached with the Delissalde solvent, but the efficiency of the contact was such that only 75 to 90 per cent of the total that could have been extracted under favorable conditions was dissolved.

The most difficult tailing at Pachuca that I have ever tested contained a considerable amount of very fine sand, most of which passed a 200-mesh screen. The presence of a large amount of clay prevented us from treating this particular material. For years the minus-200-mesh percentage was excessive; the actual sand present, however, could have been separated by classification, providing an ideal material to leach if we had then known of some satisfactory way to handle the classifier overflow. I confess a penchant for separating out the sand from tailing and dump material so as to introduce for a goodly part of the tonnage a simple and inexpensive equipment and treatment.

The treatment of the overflow from the classifier, to be sure, is a difficult, though an interesting, metallurgical problem, yet it may be satisfactorily solved; at least it has been in some operations that have come to my knowledge. Cyanidation has a good brief for itself if the usual high consumption may be economically remedied by regeneration. Some of this fine tailing responds moderately to flotation; but, even after cleaning, the concentrate is likely to be dirty and of low grade. Any leaching scheme, of course, is out of the question, and our experience at Pachuca indicates that agitation with Delissalde, Russell, or similar salts has nothing to offer.

In developing a method profitably to treat old tailing from original "dry" ore and similar dump material, besides considering modern ways and means, some suggestions may well be found in reviewing the work of a few decades ago on silver ores. Especially would I recommend Collin's "The Metallurgy of Silver," Hofmann's "Hydrometallurgy of Silver," and Stetefeldt's "Lixiviation of Silver Ores." P. ANDRUS BABB.

Mexico, D. F.

The Scope for Human Engineering

What May Be Expected of Mr. Hoover as President

In a recent issue of the New York *Times,* Mr. John V. W. Reynders wrote, *inter alia,* as follows:

"Engineers do not differ radically from other human beings, and, above everything else, they are not human machines. The materials of engineering are not confined to steel and cement and stone, but are intensely charged with the human element. No engineer can expect to achieve greatness who is unconscious of this outstanding fact. General Goethals's greatest contribution to the building of the Panama Canal was human engineering, and Herbert Hoover, wherever he went, dealt with this necessary content of successful engineering quite as much as with the problems of mining, metallurgy, and transportation.

"But there is one phase of engineering that is of the very essence, and that is accuracy of thinking. There is no such thing as glossing over inaccuracy in the concept or execution

of an engineering job. A structure stands or falls, a machine runs or stalls, a mine pays or loses, in so far as the directing mind has been accurate or at fault. There is no useful alibi in the sphere of engineering.

"Mr. Hoover is not going to create a new era in this country. The new era is already here. We may not like the kind of an era, but that will not change the fact that humanity has become mechanized, with all that the term implies. There is a dynamic potentiality in a homogeneous body of 110,000,000 people, reinforced as we are by mechanical power, for which there is no precedent in history. The effect upon our institutions, upon our industrial and financial organization and, above all, upon our social system is beyond the measure of any existing yardstick.

"Is it not fortuitous to a degree that for a period of years we will have at the helm one whose mind, from the force of circumstances, has been trained to think in accurate terms, which is the very basis of engineering?

"No one who has had the slightest touch with Mr. Hoover will harbor any doubt as to his human qualities—he does not talk human sympathy, he breathes and lives it.

"If, as is not unlikely, we are living in a period of transition involving a new set of economic factors, Mr. Hoover's executive qualities, reinforced by his engineering background and supplemented by his humanitarian experience, would seem to constitute a timely and happy combination."

The Origin of Magnetite in Copper Smelting

To the Editor of "E.&M.J.":

The articles that you have been publishing recently on metallurgical plants in the Southwest have been interesting and instructive. May I ask for a further bit of information?

In the remarks on reverberatory smelting and the treatment of converter slag therein, reference is made repeatedly to the presence of magnetite. Does this difficulty chiefly lie with the magnetite in the converter slag or from magnetite in the calcines?

There probably is some method of controlling magnetite superior to those now in use, but I doubt that smelting of raw concentrate with converter slag will prove really effective with the present methods of working the furnace. I have been making an extended study of this problem for several years.

METALLURGIST.

[It is our understanding that when magnetite causes trouble in reverberatory smelting, that fact is almost entirely the result of its presence in calcines from roasting furnaces. Magnetite can, of course, be produced in a converter, and is often made purposely by blowing without flux in order to put a coating on the brick lining. However, in the ordinary course of operation, there is ample flux present to combine with the iron oxide before any magnesite is formed. The feeding of green concentrate to reverberatory furnaces, without roasting, is not likely to be generally adopted because of the excess of sulphur contained in the ordinary concentrate. It is probably cheaper to drive off the sulphur in a roasting furnace than in a reverberatory furnace or a converter. The troubles, however, incident to the smelting of a damp concentrate are mechanical rather than metallurgical; if a good method of feeding the material were developed, there seems no reason why the practice should not be a great success where the conditions are favorable.—EDITOR.]

Tin and Mica in South Dakota

To the Editor of "E.&M.J.":

There seems to be some mud coming my way, so I herewith take up my side of the triangular battle and proceed to make ink fly, if not mud. Mr. Crill, the state Secretary of Agriculture, says the tin mill here is the largest and the mine the greatest of all tin mines, that I told him this and, further, that I wanted publicity. I therefore now come hopefully to the bat.

Your esteemed publication has asked me twice for information for publication on the Tinton enterprise—once directly and once through your correspondent at the S. D. School of Mines. In both instances I replied that we wished to wait. Now, Mr. Crill did succeed in breaking through a rather weak defense, but not, as he says, because I desired publicity, but because Mr. Crill is Mr. Crill, and I like his efforts at boosting for our natural resources. But when he calls me a promoter, I must demur and point to him as a promoter; and when he says we have the greatest of tin mines—well, I shall take some more ink later and deny that we even consider it a tin mine. Or do we?

However, people out this way expect me to carry on as a publicist, as my efforts at golf as well as mining articles will attest, and I hope that my self-indulgence in giving Mr. Crill the data will be excused on the grounds that I wished to help Mr. Crill, and the Black Hills.

Now, as to his superlatives: Oddly enough, we have vast deposits of tin ore which have been amply proved by four acres of stripping, 4,000 ft. of underground work, and two most valuable series of core-drill holes. However, the ore is hardly ore without its mica contents. We came here not for tin but for mica; and particularly to exploit several patents relating to the production, by mechanical means, of a clean product for making ground mica. This process, the first successful one, enables the production from small mica plates, in pegmatite, of a clean mica without using water—thus avoiding the expense of drying.

These deposits contain quite the largest quantity of this type of mica, and also much the largest quantity of the accessory minerals cassiterite and tantalite, known in pegmatites. We have widths up to 600 ft. of ore adaptable to power-shovel mining. Mr. Crill refers to the largest tin mill, which is quite justified if our method of concentration can be called milling. The ore occurs in alternate bands, the tin in the albitic, and but little in the quartzose bands. One thousand tons per day will go through the primary breaker, but with the lower-grade ores 75 per cent of this will be thrown out by hand before reaching the cone crusher. However, I hope to give you a full account of our enterprise after we have made some money, for the whole project rests on new processes which must first be proved in commercial practice before they can be really interesting to the profession. The early work on mica separation was reported in the *E.&M.J.* for June 28, 1919, and later abstracted by "Lefax." It is a long while back, and even yet there is little to show for the work, although Mr. Crill thinks there is a good deal.

Tinton, S. D. JOHN BLAND.

Re-treating Gold-Silver-Mercury Tailing

To the Editor of "E.&M.J.":

I found the article entitled "Retreatment of Comstock Tailings," in the Sept. 22 issue of *E.&M.J.*, very interesting because of work I did on a similar tailing from Mexico.

I would like to ask the authors if they considered the possibility of cyaniding the tailing for the recovery of the gold, silver, and copper and the recovery of the mercury by means of a sodium sulphide solution wash, the copper to be recovered as a byproduct in the regeneration of the cyanide.

Lowering of the silver extraction because of the zinc accumulating in the solution, which the authors state was due to the precipitation of the copper by zinc dust, appears to me to be easily solved. Judging from my experience with ores containing copper soluble in cyanide solution, the amount of copper precipitated by the zinc dust may be controlled. A factor to be considered is that a cyanide recovery process (such as the Mills-Crowe process) would permit bleeding a certain tonnage of solution, which would keep down the accumulation of zinc and copper in the plant solutions.

Judging from the figures in tables II and III, the higher recovery of gold and silver by the cyande process would much more than pay for the cyanide regeneration and the cyanide loss. I realize that concentrating the mercury into a comparatively small bulk permits the recovery of the mercury by distillation.

I would like to ask the authors if any work was done to determine if the flotation concentrates could be cyanided and the mercury recovered by distillation or a sodium sulphide wash. I

would also like to ask what method was used for the mercury assay.

Carmel, Calif. PAUL C. SCHRAPS.

To the Editor of "E.&M.J.":

The questions which Mr. Schraps raises in his letter will largely be answered in a more extensive article on the cyanidation of precious metals associated with minor copper values which we are now preparing for publication as a U. S. Bureau of Mines technical paper. The article includes the action of each copper mineral and records results on several precious metal ores containing under 1 per cent copper, using the proposed sulphide-acid precipitation method. It will contain a chapter giving the solubility of zinc minerals under the usual conditions of cyanidation, with experiments showing the limitation of zinc fouling that effects the cyanide dissolution of precious metals.

Approximately half the mercury occurring in the tailing referred to is recoverable under the proposed cyanidation method. An auxiliary wash with excess sodium sulphide solution was not considered, as the value of the remaining mercury would not pay for the operation, even assuming that the conditions for dissolving mercury could be worked out successfully.

The simple acid method for the recovery of cyanide from waste solutions does not recover the cyanide combined in the copper-zinc product obtained by this precipitation.

Cyanidation of this flotation concentrate either before or after distillation of mercury would result in excessive cyanide loss.

A variation of the Eschka method was used to determine the mercury in the original tailing and products. Tailings containing organic matter, sulphur, oils and base metals are difficult tc analyze for their small mercury content The Rare and Precious Metals Experiment Station of the U. S. Bureau of Mines, at Reno, Nev., is now preparing an article on this subject.

E. S. LEAVER AND J. A. WOOLF.

Reno, Nev.

The Situation in Mexico

To the Editor of "E.&M.J.":

The present bands of so-called Revolutionary Catholics in southern Mexico are usually headed by fanatics and composed largely of bandits who have no religious feelings or scruples to curb their ferocity. The outcome appears to be of somber hue, with a government unable to concede modification of the existing law, while the atrocities continue and a few fanatics attempt to offer a reason for the existence and subsistence of bands of savage bandits. These bands will follow anyone who can lead them under any flag with chances of loot; and so the pretty game goes on and will continue until the government allows liberty of religious thought throughout the country.

On Sept. 16 I was traveling from Queretero to Guadalajara on a train that, fortunately, was three hours late. The train was due to arrive at Monte Leon, near Yurecuaro, at dawn. Some ten kilometers before reaching the hill, the military guard, without which no trains move nowadays, noticed that the telegraph line had been cut. The train was stopped and the damage repaired. The military were aware that a revolutionary band was in the vicinity and therefore advised the engine driver to proceed slowly. We would probably act differently, by sending the troop cars ahead of the train to investigate. We must suppose that Independence Day (Sept. 15) being just over, the engineer, who had two unauthorized friends with him in the cab, did not take great notice of the warning, as he and three others were killed in the derailment which took place at Monte Leon when the locomotive turned over and three cars were smashed. Immediately the shock of the derailment occurred, all the passengers prepared for the firing to begin, as is usual in such cases, but were agreeably surprised to hear nothing further, and were later able to congratulate themselves that the only sufferers were the four killed above mentioned. In two hours the passengers were transferred to another train and arrived in Guadalajara that night.

I examined mines on the Santiago River after leaving Guadalajara, but, owing to the numbers of roving bandits in the vicinity, I was only able to carry out this work by riding on unfrequented paths. Scouts were kept on all trails around the properties examined, to warn the manager in time; and on one occasion the manager and I had to ride over to a ranch to sleep, as it has become a lucrative business for bandits to hold Americans for ransom.

The British Consul in Guadalajara, acting as agent for various companies, has paid eight different ransoms. The last was that of Mr. Bumstead, to the tune of $10,000. Jalisco, Nayarit, Puebla, and Michoacan are the most bandit-ridden states at present. Ranchers are frequently robbed and girls abducted in all those states. ENGINEER.

El Paso, Tex.

Consultation

Roan Antelope Financial Structure

"Please advise me the name of the American company, or the British company, exploiting the Roan Antelope copper deposits, mentioned in your issue of Sept. 15, and tell me where the shares may be purchased."

The name of the British company is Roan Antelope Copper Mines, Ltd., Selection Trust Building, Mason's Ave., Coleman St., London, E.C. 2, England. The authorized capitalization of this company is 4,000,000 ordinary shares of a par value of 5s., of which 3,400,000 shares will be outstanding on completion of the current financing. Of the authorized but unissued shares, 50,000 are to be reserved for subscription by employees, and 150,000 will be reserved for the acquisition of adjacent property under option to the company. The shares are listed on the London Stock Exchange and may be bought through any broker having London connections.

Of the outstanding shares, 800,000 are out of the market, as they have been deposited against an issue of 200,000 so-called American shares, redeemable on request for the British shares at the ratio of four for one. The issue price of the American shares was $24, but they have recently sold for several dollars above that figure on the New York Curb. Any broker with Curb connections can buy them. The American Metal Company is said to be a large holder of both the American and British shares, estimates giving it from 23 to 33 per cent stock interest.

Recently published data show 30,000,000 tons of sulphide ore proved, averaging better than 3.25 per cent copper. An increase to 50,000,000 tons is expected with further development, and the property under option has possibilities. A pilot plant, operating for the last year, indicates the proper treatment to be simple flotation followed by reverberatory smelting and converting, without electrolytic refining. A. G. McGregor is building the plant. A production of 50,000 tons of copper per annum, in three years, is the aim. Costs are estimated at 8c. per pound, c.i.f. Europe, exclusive of taxes and depreciation, which would result, with copper at 15½c., in a gross profit of over $7,000,000 annually, or perhaps about $5,500,000 available for distribution to the stockholders. A variation of copper prices of 1c. per pound would affect gross earnings by about $750,000.

To complete the plans is expected to require about $15,000,000. Recent financing was expected to yield $5,000,000, which will take care of all expenditures for fifteen months. Additional funds will then be raised as required.

Wanted—A Geological Journal

"Please give me some information regarding a journal devoted to pure and applied geology, especially in regard to mining. Please tell me also the subscription price. Only a serious publication will be considered."

Our correspondent will undoubtedly find what he wants in *Economic Geology*, issued eight times a year by the Economic Geology Publishing Company, Prince and Lemon Streets, Lancaster, Pa. The price is 75c. per copy, or $5 per annum.

INDUSTRIAL PROGRESS

Controlling Reagents in Flotation

Various Apparatus Devised for Determining Hydrogen-Ion Concentration

NEED for closer control of reagents in flotation has been brought about by widespread adoption of the selective process. For determining the acidity or alkalinity of a solution, apparatus of various sorts is readily available to the metallurgist and chemist.

Effective acidity and effective alkalinity of a solution are determined by measuring the concentration of hydrogen ions in it. This may be done accurately by measuring with a potentiometer the difference in potential between two suitable electrodes in contact with the solution. The concentration of ions can then be found from a table showing the relation between voltage and concentration. This relation being definitely known, it is possible to calibrate the scale of the potentiometer to indicate directly the *pH* value, as the unit used to express acidity and alkalinity numerically is known. Based on this method of measurement, a colorimetric method has also been developed. This is naturally less accurate.

Principles underlying the electrometric method for measuring hydrogen-ion concentration are described in textbooks and in the bulletins issued by various makers of chemical apparatus. In particular, Bulletin No. 75, issued by Leeds & Northrup Company, Philadelphia, goes into the subject rather fully. Bulletin No. 776 of the same company deals with a potentiometer intended for such measurement.

Two Types of Standards

Hydrogen-ion testing apparatus, as it exists today, has two types of standards. One is the potentiometer type, with its fixed calomel half-cell and hydrogen-electrode reference standards. This is the basic type. The other is the colorimeter type, based on the potentiometer type as a standard, but employing a series of colors for its standards. The first type leaves nothing to be desired in the way of permanency and reproducibility, but it requires some knowledge of the basic principles of physical chemistry for its operation. On the other hand, the colorimetric type is reproducible, is less expensive, requires little technical knowledge, and is more quickly operated. But colored solution standards are not permanent, and change gradually from the day they are made; this is particularly true of the strongly acid and strongly alkaline ranges. Solution standards must therefore be repeatedly checked and replaced.

For Preliminary Testing

The so-called flotation testing set introduced by the La Motte Chemical Products Company, of Baltimore, at the suggestion of the American Cyanamid Company, has already been described in detail in these pages (*E. & M. J.*, June 23, 1928, p. 1024). It consists of a series of five indicator solutions which provide a scale for determining, by colorimetric means in conjunction with a color chart, the hydrogen-ion concentration, or *pH*, of a solution. The results thus obtained are said to be fairly accurate. The set, however, is intended primarily to familiarize the worker with the method and allow him to determine just what equipment is necessary for accurate control work, after which he should use a roulette comparator or several block comparators to cover the necessary range.

Unchanging Color Standards

Need for a colorimetric method for determining *pH* values by means of standards which will not change color is met by a new glass standard *pH* indicator introduced by the Fisher Scientific Company, Pittsburgh. Its standards are the proper color and have been checked by the potentiometer method; these colors cannot change with time or use, according to the maker.

The following principle is embodied in this *pH* indicator: Light from a source of illumination passes through a diffusion screen and is split into two rays—one passes through a cell containing distilled water and then through the standard color glass. The other ray passes through the cell containing the solution, the *pH* of which is to be determined, and to which several drops of the indicator has been added. Then the two fields are brought into juxtaposition by a prism and are viewed by a monocular eyepiece.

A disk holding the standard color glasses is rotated until a color match is obtained at the eyepiece, and the *pH* of the solution is that corresponding to the *pH* value of the glass in view. This is read through a small window in the front of the instrument. The glass cells employed are rectangular in cross-section and have optically plane-parallel sides. This eliminates the varying color intensities occurring when test tubes or cylindrical cells are employed, in which case the depth of liquid is greater at the center.

The *pH* standards of reference are interchangeable disks, each containing eight to ten circular standard color glasses. These disks are inserted in a slot in the right side of the housing and rotate on a shallow spud so that the color glasses successively rotate into the field of view. Each disk covers a definite range of *pH* units as follows:

Indicator	*pH* Range in Steps of 0.2 *pH*
Thymol Blue, acid	1.2 to 2.8
Bromphenol Blue	3.0 to 4.6
Methyl Red	4.4 to 6.0
Bromthymol Blue	6.0 to 7.6
Phenolphthalein	8.4 to 10.2
Alizarin Yellow	10.2 to 11.6
Violet	12.0 to 13.6
Universal Indicator	(a) 4.5 to 9.0

(a) In steps of 0.5 *pH*.

The actual indicator solution which is added to the unknown solution comes already prepared for use, so that it is only necessary for the operator to add two or three drops and, after shaking, compare with the standard color disk. To determine the *pH* of turbid or colored solutions, the distilled water cell is filled with the unknown solution, without indicator, and the other cell is filled with the unknown solution with the indicator.

Another set of apparatus using nonfading glass standards is the Hellige comparator (Eimer & Amend, New York). This comparator makes use of glasses which are rectangular plates inclosed entirely in a glass housing, acid- and dust-proof, thus forming a convenient color scale. The capillary tube which contains the solution to be tested, together with the indicator, is held by a metal rider which moves along the color scale. This rider has a milk-glass back for diffusing the light, an opening in front for securing the proper color field, and two openings at the margin for reading either the horizontal or the vertical *pH* values, depending on how the rider is placed on the scale. Each color scale is marked horizontally and vertically with the corresponding *pH* value for readings in either position of the apparatus. The color comparison may be made and the *pH* value scale can be read from one point of observation. As the color fields are close together, a good match is said to be obtained. The metal rider can be used with any of the glass color scales. Only one drop of test solution is required with this outfit for measuring hydrogen-ion concentration.

The *pH* of a solution is measured by means of electrode potentials as follows: The electrical potential between certain electrodes and the solution depends upon the *pH* of the solution. In making the determination the electrode is connected to one terminal of a voltmeter, the other terminal being connected to an electrode whose potential is constant and does not depend upon the *pH* of the solution. The electrode whose potential varies when the *pH* is changed is called the indicating electrode, and the one whose potential remains constant is called the reference electrode. The solution into which the reference electrode is placed need not be the one whose *pH* is wanted; if a different one is used, the two solutions are joined by a salt-bridge. In practical work perhaps the commonest reference electrode is a mixture of mercury and mercurous chloride, which is surrounded by a saturated solution of KCl and mercurous chloride. This is called the saturated calomel half-cell.

The most important indicating electrode is called the hydrogen electrode, and consists of a piece of platinum or gold which has been coated (electrolytically) with platinum black and then saturated with hydrogen gas. So long as this electrode is saturated with hydrogen, the potential between it and a reference electrode bears a simple relation to the *pH* of the solution into which it is placed. The potential, in volts, is $E = E_o + (.059)\ (pH.)$

The constant term E_o, depends upon the kind of reference electrode which is used; for the saturated calomel cell it is 0.25 volts. Thus in a solution whose *pH* is zero, the potential would be 0.25 volts, while in a solution whose *pH* is 14, the potential measured would be $0.25 + (0.059)\ (14) = 1.076$ volts.

In order that the electrode may be kept saturated with hydrogen, it is necessary to keep the surface continually exposed to pure hydrogen gas, and practically no current must be allowed to flow into or out of the electrodes. This latter requirement makes it impossible to use an ordinary voltmeter to measure the potential between the electrodes. Most potentiometers operate upon the alternative principle of balancing an equal and opposite potential against that of the electrodes.

Uses Vacuum Tubes

An instrument of this general type, but using an extremely small amount of current to operate it, in which no risk of injuring the electrodes is run, is the so-called "Acid-Alkalimeter," introduced by the Palo Company, New York. This is a voltmeter which draws only an extremely small current from the electrodes. Two vacuum tubes of special design are employed to this end. The first tube is connected so that its grid is affected by the potential to be measured and its plate circuit resistance operates the grid of the second tube. The plate current of the second tube is measured by means of a milliammeter with a special scale. By specially adjusting the instrument it is possible to make each division of the milliammeter correspond to one unit of *pH*, provided certain kinds of electrodes are employed. After this adjustment has been made, another scale of the meter, which reads directly in *pH* units, may be used to make the determination.

Controlling Acid Strength

Automatic control apparatus designed to maintain a uniform strength of acid in a bath has been introduced by Leeds & Northrup Company, Philadelphia. At the same time it furnishes a continuous record of the concentration of the bath, so that the operator may know not only what the acid strength is at a particular instant but also what it has been at all stages of the process. This controller will hold the strength of a dilute acid bath constant within narrow limits. For example, if the concentration is to be maintained at 3 per cent acid (4 deg. Twaddell), the control device is set to operate at that point, and it will keep the acid strength continuously within the limits of 2.9 per cent (3.86 deg. Twaddell) and 3.1 per cent (4.14 deg. Twaddell.)

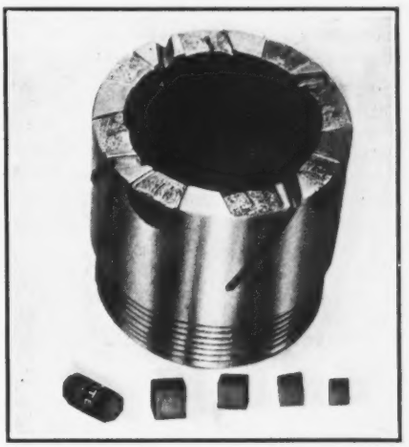
The control method is based on the fact that the bath solution will conduct electricity and that the electrical conductivity of the solution varies with the concentration of acid. If a conductivity cell with two fixed electrodes is immersed in the solution, a current of electricity flowing from one electrode to the other will increase or decrease as the acid strength rises or falls. To control the concentration of acid, a conductivity cell in the bath is made to form a part of the electrical circuit in an instrument that is sensitive to changes in conductivity, and responds in one direction to an increase and in the opposite direction to a decrease in concentration of acid. In responding to such changes the instrument puts in operation a valve mechanism that regulates the flow of acid to the bath, until the conductivity is equal to that of a solution with the required concentration of acid. Thus the acid strength is maintained by controlling the conductivity of the bath.

The Equipment Review

DUST REMOVAL is a subject in which increasing interest is being shown by mining companies. A device for eliminating dust hazards in industrial plants was exhibited recently at the All-Ohio Safety Congress, held at Columbus on Nov. 13 to 15. This was a model of the latest type of Norblo air-filter, made by the Northern Blower Company, Cleveland. This new piece of equipment is entirely self-contained, and is provided with an electric fan drive and an electrically driven compressor for operating the air valves and shaker mechanism which automatically keep the filter bags clean and efficient by reversing the direction of the flow in each unit in rapid succession. The model is large enough to permit dust-collecting tests to be made on a working scale and to demonstrate the possibility of making inspections, repairs, or even extensions to this type of air filter without interfering with its continuous operation.

A Substitute for Diamonds

There is no real substitute for black diamonds as a material for setting core-drill bits when rate of progress and cost per foot of hole drilled in any formation are the only factors to be considered. Under certain conditions, however, the possibilities of a substitution have been recognized. The Sullivan Machinery Company, Chicago, has recently announced the development of a metallic alloy, known as "Sulamite," which has practically the same characteristics as carbon or black diamond, with the exception that it is not as hard. This material is nevertheless considerably harder than emery, corundum, and similar abrasives. In competition with other substitutes it is said to have proved its superiority both in laboratory and in field work. The process of making it is a trade secret. A bit set with it is shown in the accompanying cut. The company states that in igneous rock and hard sedimentary or metamorphic formations



Core-drill bit set with substitute for diamonds that is suitable under certain conditions

black diamonds are without competition, which is also true in sharp or abrasive rocks. In working on soft sandstone, soft limestone, shale and other relatively soft sedimentary strata, however, the new material has been used effectively. In such operations the lower first cost of the investment for the cutting material, as compared with that of diamonds, offsets the slower progress and the higher cost per foot drilled. When these formations are cavey or pockety, as is often the condition, the possibility of sticking the tools and of injury to or loss of the diamond bit makes the use of the substitute advisable from the

viewpoint of economy. The new material is furnished in cubes and in octagonal pieces.

Another New Tool Material Developed

A new kind of machine-tool material has recently been announced by Dr. S. L. Hoyt, of the General Electric Research Laboratory. It is known as "Carboloy" and is composed of tungsten carbide and cobalt, the carbide making it extremely hard and the cobalt giving it the necessary strength for cutting tools. Its possibilities were indicated by the following, according to Dr. Hoyt: Cobalt-chromium alloy cutters, which had given the best previous service in cutting gears, required redressing for every 150 parts machined; the new tungsten-carbide tools, operating under identical conditions, finished 11,000 parts before requiring sharpening. The new material is said to retain its strength and hardness at elevated temperatures to a remarkable degree.

Development in Transmission

Recently a line of herringbone speed reducers has been placed on the market by the Palmer-Bee Company, Detroit. In these anti-friction bearings are used throughout—ball bearings on the high speed, Hyatt bearings on the intermediate, and tapered roller bearings on the slow-speed shaft. The gears are of the continuous-tooth herringbone type, with a silent tooth form, producing more rolling and less sliding action than heretofore obtainable, according to the manufacturer. A three-point method of mounting is employed in bolting the reducer to the sub-base, thus facilitating the alignment of the drive. No outboard bearings are required for overhung loads up to the maximum rated capacity of the reducer. It is claimed that the efficiency of the single series reducers is approximately 99 per cent and of the double series about 97 per cent.

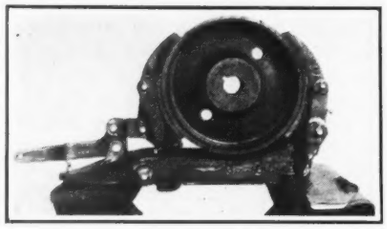
The Link Belt Company, of Chicago, has announced that it has increased the range of horsepower in which silent chain drives can be furnished from stock from 15 to 60 hp.

Testing Insulating Oils

A new ½-kva. portable oil testing set which accurately determines the dielectric strength of insulating oils up to 25,000 volts has been developed by the Westinghouse Electric & Manufacturing Company. It is mounted in a cast-aluminum case, and comprises, in addition to the transformer, a double-pole self-restoring push switch, a control rheostat, a portable plug for connecting to an ordinary 110-volt light socket, a voltmeter calibrated in kilovolts, and an oil test cup fitted with standard testing electrodes and a feeler gage for setting. Tests have shown that as little as 0.005 per cent of moisture will reduce the dielectric strength of oil to about one-half of its strength when dry. To make sure that the proper strength is maintained, the oil in any piece of apparatus should be tested frequently and regularly.

A New Brake for Cranes and Hoists

In the accompanying illustration is shown a new brake arranged for lever operation which has been built by the Electric Controller & Manufacturing Company, of Cleveland. This is of the shoe type and is intended for the bridge drives of electric traveling cranes, lift bridges, electric hoists, and other applications requiring foot-operated or hand-lever operated brakes. It is a modification of the company's type WB electrically operated brake. Practically all wearing parts are interchangeable with the parts of the electrically operated brake.



A mechanically operated brake for traveling cranes

Another Belt Conveyor Idler

Among the features claimed for a new conveyor idler introduced by the Chicago Automatic Conveyor Company, 1845 South 55th Ave., Cicero, Ill., are the following: The pulleys are spaced ¼ in. apart to avoid belt creasing; heavy steel tubing is used for them; the tubes have steel heads which are electrically welded flush with the ends, thus eliminating dust pockets. Ball bearings are used in the idler, a unit mounting being provided to keep them in alignment. This mounting also serves as a grease reservoir. Dust and grit are prevented from getting into the bearings by a labyrinth grease seal, which also prevents the grease from being thrown on the belt. Heavy cast-iron brackets, accurately machined, are used.

INDUSTRIAL NOTES

The C. F. Pease Company, Chicago, has moved its New York sales office to 12 East 44th St.

The new brass and copper plant of the Chase Brass & Copper Company of Waterbury, Conn., will be erected in Cleveland, Ohio. It will meet the company's need of a mid-Western mill, which has been accentuated by its recent acquisition of the U. T. Hungerford Brass & Copper Company.

The Anaconda Copper Mining Company, through its subsidiary, the American Brass Company, is rebuilding its electrical cable plant at Hastings-on-Hudson, N. Y. This plant will be equipped to produce the highest-quality power cable of all types. An up-to-date testing laboratory will be provided.

E. H. Guilford, general manager of the Radiore Company of Canada, has just returned to Montreal from a flying trip to Los Angeles and Vancouver.

PATENTS

MAGNETIC ORE SEPARATOR. No. 1,686,917. Oct. 9, 1928. William L. McAdams, Coquille, Ore.

CALCINING FURNACE. No. 1,686,565. Oct. 9, 1928. James H. Knapp, assignor to Tate Jones & Company, Pittsburgh, Pa.

ORE-GRADING MACHINE. No. 1,685,828. Oct. 2, 1928. Vicente Sanchez, Ponemah, Ill.

ROCK DRILL VALVE. No. 1,687,381. Oct. 9, 1928. Gustave M. Nell, assignor to the Cleveland Rock Drill Company, Cleveland.

METALLURGICAL FURNACE. No. 1,687,470. Oct. 9, 1928. Howard Butt, assignor to Riley Stoker Corporation, Worcester, Mass.

SKIP DUMPING APPARATUS. No. 1,687,278. Oct. 9, 1928. Andrews Allen, assignor to Allen & Garcia Company, Chicago.

EXPLOSIVE. No. 1,685,771. Oct. 2, 1928. Frank H. Bergeim, assignor to E. I. du Pont de Nemours & Company.

This covers a cyano nitrate explosive compound and the process of producing it.

STEEL METALLURGY. No. 1,686,206. Oct. 2, 1928. H. G. Flodin, of Roslags-Nasby, and Emil G. Torvald Gustafsson, Stockholm, Sweden.

A method of producing metals or metal alloys low in carbon directly out of the ore or other compound.

SCRAPER LOADER. Nos. 1,686,147 and 1,686,148. Oct. 2, 1928. Charles E. Davis, assignor to Goodman Manufacturing Company, Chicago.

These patents cover respectively a combined loading chute and transportation device and the scraper used with it.

FLOTATION. No. 1,686,529. Oct. 9, 1928. Rhetherford B. Martin, assignor to Minerals Separation North American Corporation, New York.

Floating a sulphide ore, with the aid of an organic compound carrying nitrogen and copper and capable of producing a froth.

CONCENTRATION. No. 1,686,064. Oct. 2, 1928. Frank A. Bird, Salt Lake City, Utah.

The process of treating oxidized ores to render them amenable to concentration by the flotation process which consists in grinding in a mill free from metal surfaces with which the ore would be likely to make contact and subjecting the ground ore to a sulphidizing agent whereby to deposit a film of sulphide thereon.

REDUCING SULPHATE ORE. No. 1,685,772. Oct. 2, 1928. J. E. Booge and J. P. Koller, assignors to E. I. du Pont de Nemours & Company.

A process of producing a powdered sulphate ore containing more than 4 per cent of silica and held together in substantially non-porous tablets or briquets by a suitable binder which depends upon its coking properties for its binding action.

CONCENTRATING TABLE. No. 1,685,986. Oct. 2, 1928. Emil Deister, Fort Wayne, Ind.

A concentrating table having a deck transversely inclined downwardly from its head end toward its foot, together with a means of imparting a reciprocating motion; also a series of upwardly inclined stratifying launders on the declined surface of the deck diagonally disposed relatively to the line of reciprocating movement. The bottom of the launder projects laterally from the declined surface and is substantially level transversely. Means are provided for feeding dressing water to each launder.

Recent Technical Publications

Ore Investigation and the Specialist

THE LABORATORY INVESTIGATION OF ORES — A SYMPOSIUM. *Edited by Ernest E. Fairbanks. McGraw-Hill Book Company, 370 Seventh Avenue, New York. Two hundred sixty-two pages. Price, $3.50.*

A SYMPOSIUM on a technical subject such as this bears a relation to a textbook somewhat like that which a vaudeville show bears to the regular drama. A variety of style and viewpoint is offered, and the reader finds frequent places where he may stop conveniently without feeling that he is leaving something unfinished. Indeed, it recalls the Scotchman's opinion of the dictionary, that it contained "bra' stories, but verra short." Twelve specialists have contributed to the discussion of technique, geological application, and metallurgical application. Their contributions are as follows: Geologic Thermometry, by N. L. Bowen, of the Geophysical Laboratory, Carnegie Institution of Washington, D. C. Ore Mineral Sequence, by R. J. Colony, Columbia University. Crystal Analysis by Means of X-Rays, by Wheeler P. Davey, Pennsylvania State College. Microscopes, Their Construction and Use, Dielectric Methods, Zonal Distribution, by Ernest E. Fairbanks, Buffalo Museum of Science, Buffalo, N. Y. Enrichment of Silver Ores, by F. N. Guild, University of Arizona. Genetic Significance of Grain, by Alfred C. Lane, Tufts College, Medford, Mass. Practical Photomicrography, by R. P. Loveland, Eastman Kodak Company. Microscopic Criteria of Replacement in the Opaque Ore Minerals, by W. H. Newhouse, Massachusetts Institute of Technology. Ore Dressing Microscopy, by G. M. Schwartz, University of Minnesota. The Textural Relationship of the Opaque Manganese Minerals, by G. A. Thiel, University of Minnesota. Practical Photomicrography, by A. P. H. Trivelli, Eastman Kodak Company. Waldemar Lindgren also contributes a historical review of the study of polished sections of opaque minerals.

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MINING LAWS.—The British Imperial Institute has recently added another volume to its series of Mining Laws of the British Empire and of Foreign Countries. This is Vol. IV, Part 2, which deals with mining legislation in Ontario and may be regarded as corrected to April 5, 1927, inasmuch as its appearance has been delayed somewhat to include the important changes in the law effected by the mining act of 1927 and the mining tax act of the same year. It contains 334 pages. Copies may be obtained in the United States from the British Library of Information, 5 East 45th St., New York; price $7.75, postage extra. The countries whose mining laws have been covered in the previous volumes of the series are as follows: Nigeria, West Africa, South Africa, including the Transvaal, Swaziland, and Orange Free State; Canada, including British Columbia, Ontario, and the Dominion; Australia, including New South Wales (in preparation) and Victoria; British India, Federated Malay States, East Africa and British Guiana.

MINING STATISTICS — Two government publications containing statistical information relating to the mining industry have been received. The first is entitled "Statistical Abstracts of the United States for 1928." Included in the vast amount of data that one would naturally expect to find in its 841 pages are some 44 pages of tabular matter dealing with mining and mineral products. For the most part these relate to prices and production, being gleaned largely from reports of government bureaus and various other statistical sources. The other book is the 437-page volume entitled "Statistics of Income from Returns of Net Income for 1927," which has just been released by the Treasury Department. A vast deal of information is condensed within the covers of these two books. Its value in spots is doubtful. One must know where to look for it, in the first place, and be able to interpret it after one has found it, if its value is to be realized.

MUDDY MOUNTAINS GEOLOGY—Bulletin 798 of the U. S. Geological Survey, by Chester R. Longwell, has just made its appearance. The greater part of the field work on which the report is based was done in 1919. In it is covered the geology of the Muddy Mountains, Nevada. A section through the Virgin Range to the Grand Wash Cliffs, Arizona, is included. The Muddy Mountains are in the eastern part of Clark County, north of the Great Bend of the Colorado River. On the east the range is separated by the Virgin River from the Virgin Mountains, which extend into Mohave County. The area covered by the report is 52 miles in maximum length and runs east and west. In all 1,000 square miles is included. The region has been practically unmapped, and is therefore one of strong appeal to the geologist.

MINING IN NEW SOUTH WALES—The mineral resources of New South Wales are described in a 432-page volume just issued by the Department of Mines of that state. It has been prepared by E. C. Andrews and the staff of the Geological Survey. The price is 7s. 6d. This is the first bulletin to appear on the subject since the Department of Mines issued "The Mineral Resources of New South Wales" in 1901. The new bulletin is not merely a second edition of the earlier one. It has been prepared in light of the fact that mining activity in the state has passed from gold, copper, and tin to lead and zinc, coal, and the non-metallic minerals. Numerous insert maps, line drawings, and halftones are included.

MINING, GREECE—The September-October issue of *Economic Geology* contains an interesting ten-page article by Cornelio Sagui, entitled "The Ancient Mining Works of Cassandra, Greece." In conclusion, the author states that in his opinion an archeological history of economic geology would be of interest.

MINING IN SOUTH AFRICA — The Government Mining Engineer of the Union of South Africa has made his annual report for the year ended Dec. 31 last. A copy of the volume has just arrived. It may be obtained at the price of 10s. 6d. by applying to the Government Printing and Stationery Office, at Pretoria, South Africa. The book has 177 pages.

PANAMA.—The October issue of *The Mining Magazine* (London) contains the first installment of an article entitled "Panama—Its History, People and Industries," by V. F. Stanley Low, consulting engineer to the Panama Corporation.

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Government Publications

Bulletins recently received from Government Bureaus include the following:

"Methods of Preparing and Cleaning Some Common Heavy Liquids Used in Ore Testing," by R. G. O'Meara and J. Bruce Clemmer. Reports of Investigations, U. S. Bureau of Mines, Serial No. 2897. (Free.) These include acetylene tetrabromide, methylene, iodide, thallium salts, among them thallium formate and thallium malonate-formate. Preparation and reclamation are covered.

"Determination of Flakiness of Ores," by Will H. Coghill, O. W. Holmes, and A. B. Campbell. Reports of Investigations, Serial No. 2899, U. S. Bureau of Mines. (Free.) This bulletin outlines a procedure for determining the flakiness of ores, by which material is sized on square holes and then screened on oblong holes. The authors point out that, contrary to popular belief, a Tri-State jig tailing had the zinc segregated in the flaky grains. Likewise they found that a reground jig tailing showed more dissemination in the flaky grains than in the cubical. The report, moreover, states that Tri-State chert and the dolomite of the Southeast Missouri lead belt showed about the same degree of flakiness when similarly ground; also that the discharge from rolls was more flaky than the discharge from the ball mill. In conclusion, the bulletin states that some evidence was obtained to justify a hypothesis that size of maximum flakiness in the discharge is a certain fraction of the size of the feed.

NEWS OF THE WEEK

Summary

SCOTT TURNER, director of the U. S. Bureau of Mines, summarizes the activities of that organization in various lines of work in his annual report to the Secretary of the Department of Commerce, of which the Bureau is a part. Page 842.

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Sinking of the new south shaft at Teck-Hughes Gold is proceeding rapidly and installation of the new hoist is being completed. Page 841.

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Quicksilver deposits are widely scattered over the state of Nevada. Recent high prices have caused activity in several districts, of which at least four promise to become important producing centers. Page 844.

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In Queensland the famous Mount Morgan mine, closed when $80,000,000 of ore was still known to exist, will be reopened by a Sydney syndicate. Page 843.

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The new labor amendments seem likely to be passed by the present Mexican congress, as they are strongly favored by Portes Gil, successor to General Obregon. Page 845.

* * *

Mount Isa directors have issued a statement on the progress of diamond drilling at this new lead-zinc-silver mine in Queensland. More than 12,000,000 tons are contained in the estimates for ore above the 600 level. Page 845.

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Golconda Lead has taken over Mayflower Mining & Development, which owned a group of thirteen claims adjoining the Golconda mine in the Coeur d'Alene district. Page 841.

* * *

Construction of the concentrator at Amulet Gold, in the Rouyn district, has been definitely decided on and the work will be started with the objective of producing early next summer. Page 845.

Railroad Will Be Built to Sherritt-Gordon From Flin Flon

Canadian National Railways Agrees to Undertake Construction of 42-Mile Line to Cold Lake—Hudson Bay M. & S. Will Build Electrolytic Zinc Plant as Well as Copper Smelter

AN AGREEMENT has been effected between Sherritt-Gordon Mines, in the Cold Lake district, northern Manitoba, and the Canadian National Railways for the construction of a line, 42 miles long, from the recently completed Flin Flon branch of the Hudson Bay railroad to the Sherritt-Gordon mine. The mining company gives a cash guarantee of $1,500,000 for construction of a concentrator and other necessary plants, and also offers a cash bonus of $125,000 for quick construction. The line will be built by the Dominion Construction Company, of Winnipeg, which also constructed the Flin Flon line. Work will be started immediately, and those most interested anticipate that the line will be completed by Dec. 1, 1929, at the latest. The construction of the 85 miles from The Pas to Flin Flon took only ten months.

Sherritt-Gordon owns a solid block of territory about 5 miles long in the Cold Lake district. Two shafts are being sunk at present at points about 7,000 ft. apart. The ore is copper-zinc, with small quantities of gold and silver. Extensive diamond drilling on the original claims of the company and territory obtained within the last year has indicated the existence of a large orebody. The present company was organized by the Lindsley-Errington interests, which control Sudbury Basin Mines, to take over the group of claims from J. P. Gordon and Carl Sherritt, the original discoverers. The claims had been dropped by Nipissing Mining interests and the Victoria Syndicate. It has a capitalization of $6,000,000, of which $3,000,000 was paid for the mine.

Sherritt-Gordon concentrates will probably be smelted at the Flin Flon plant, being constructed by Hudson Bay Mining & Smelting, although they may be shipped to Sudbury for treatment at the smelters there.

Of equal interest to Manitoba mining is the announcement made that Hudson Bay Mining & Smelting will build an electrolytic zinc plant, in addition to the copper smelter already proposed, at the Flin Flon property. This plant will handle custom ores from the district in addition to Flin Flon concentrates.

A battery of electric locomotives has been ordered for the open-pit mine, where about 1,000 tons of copper-zinc ore will be mined daily. Present plans call for an additional output of 2,000 tons from underground operations.

Tri-State Flotation Output in More Demand

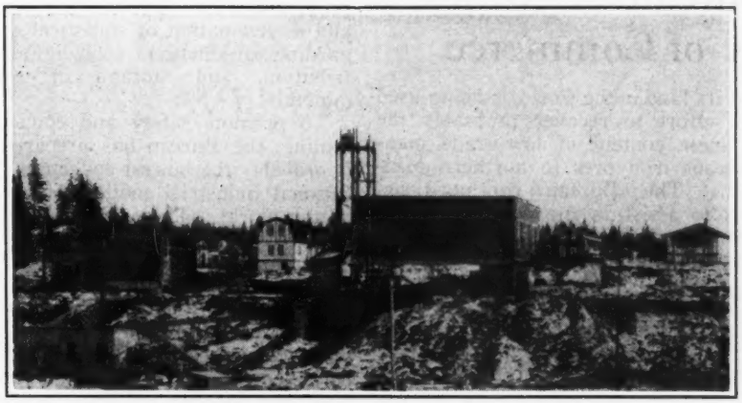
Completion of roasting units at the Donora plant of the American Steel & Wire Company, near Pittsburgh, and the Fort Smith plant of Athletic Mining & Smelting, in Arkansas, has stimulated a much greater demand for flotation concentrate from the Tri-State lead-zinc district. Flotation ore had been more or less a drug on the market for several months; one company was able to sell flotation concentrates last week for the first time in three months.

Century Builds Chat Mill

Construction of the new 400-ton chat mill being built by Century Zinc, 2 miles south of Baxter Springs, Kan., in the Tri-State district, is rapidly nearing completion, and it should be in operation by the beginning of 1929. Century Zinc is a subsidiary of Youngstown Sheet & Tube Company. Construction of a flotation plant will be delayed until experiments now under way have been finished.

Mohawk Flotation Equipment Will Be Ready Soon

Mohawk Mining expects to have its Fahrenwald flotation machine in operation at its stamp mill in the Michigan copper district by Jan. 1. Current mill tailing will be treated by the flotation process, with an expected saving of 2½ lb. of copper per ton. No attempt will be made to treat the old tailing dumped in Lake Superior, because it has been spread over too great a surface by the action of the water. The mill is treating about 2,000 tons from the mine daily. About 67 per cent is coming from the No. 6 shaft. No. 4 shaft has been worked out and abandoned.



New Teck-Hughes Shaft Will Reach 3,700 Ft. Depth

THE illustration above shows the headframe of the new south shaft at the Teck-Hughes gold mine, in the Kirkland Lake district of northern Ontario, on Nov. 14. Sinking operations at this site, which is 670 ft. south of the central shaft, are progressing rapidly, and installation of the new hoist will probably be completed by the end of January. The hoist will be capable of lifting 70 tons per hour from a depth of 3,700 ft. The first level from this shaft to connect with the central shaft will correspond with the 25 level of the central shaft. Adequate ventilation for deep levels will be obtained by both natural and mechanical means, and every possible precaution will be taken to insure safe and healthy conditions at whatever depth the mine may be worked. Eventually the Teck-Hughes workings may go as deep as 7,000 ft., present plans calling for the sinking of two winzes from the 3,500 level.

Company officials, according to the annual report by the manager, D. L. H. Forbes, do not expect that this program will add seriously to operating costs, because ample time has been allowed for its completion as far as the 30 level, and extra expense for rushing the work of shaft-sinking will be avoided. Inasmuch as it will take several years to sink the new shaft and connect it with the central shaft workings, the operators have decided to start development work on the depth program from the central shaft in the meantime. Production from the older workings is not being interfered with, however, and the mill continues to handle about 900 tons daily.

George Graham Rice Trial in New York Continues

THE trial of George Graham Rice, Frank Silva, Walter K. Yorston, Walter Harvey Weed, and *The Wall Street Iconoclast*, for using the mails with intent to defraud in the sale of stock of the Idaho Copper Corporation, continues, and may easily last another week. U. S. District Attorney Charles H. Tuttle is conducting the prosecution, assisted by Radcliffe Swinnerton, David W. Peck, and Eldridge Gerry, 3d. Mr. Rice is, in large part, conducting his own defense, though the lawyers for the defense include Nash Rockwood, David P. Siegel, James H. Nichols, Blaine Hallock, and William Cunningham. Judge John C. Knox is presiding in the court room, which is on the third floor of the old post office building, at Broadway and Park Row, New York City. The sessions, which usually begin about 10:30 a.m. and 2:30 p.m., are attracting much interest, giving the public an opportunity to make personal character studies of two or three men who have had considerable publicity in mining circles in recent years.

During the last week the sessions have been confined to the selection of the complete panel of jurymen, to the opening presentation of the case by each side, and to the examination of brokers concerned with the flotation of the stock. These included Walter L. Jarvis, of W. L. Jarvis & Company, of Boston, and Abner S. Werblin, a New York broker, who first brought the Idaho property to the attention of Mr. Rice, according to the testimony. Several of the agreements were read in court.

Walker Is Increasing Output

At the Walker mine, controlled by Anaconda Copper, output is now between 1,000 and 1,100 tons of copper ore daily, and reports are current that milling capacity will be increased to 2,000 tons a day some time in 1929. Recent development has exposed large orebodies at the property, which is near Spring Garden, Plumas County, Calif.

Golconda Lead Acquires Adjoining Mayflower Group

TO OBTAIN absolute ownership of the main tunnel through which its operations are being carried on, and to avoid any litigation over extra-lateral rights, Golconda Lead has acquired the Mayflower Mining & Development group of thirteen claims adjoining its own properties in the Cœur d'Alene district of Idaho, The Golconda company had been paying approximately $600 monthly for the use of the tunnel, which is projected through the Mayflower company's properties to reach its own property. A proposal has been made by the directors to increase Golconda's capital from 1,500,000 to 2,000,000 shares of $1 par, and a stockholders' meeting has been called for Dec. 14 at Wallace, Idaho, to vote on the increase. The additional issue, it is expected, will be sufficient to free the company from its present indebtedness of $140,000 and to acquire the Mayflower stock.

According to a report by W. G. Morris, mining engineer, of Vancouver, B. C., there is a vein on the Mayflower group which can be developed profitably and which will add a large tonnage to the ore available for the Golconda mill, recently put into operation. Shipments at the rate of about eighteen cars of concentrate monthly are being made, and the main shaft at the Golconda mine is being sunk to the 1,400 level.

W. A. Clark, Jr., Obtains New Montana Properties

SHORTLY after the W. A. Clark Montana properties were sold to Anaconda Copper, W. A. Clark, Jr., announced that he would again enter mining, and since then he has acquired the Boss Tweed and Clipper claims, situated between Pony and Mammoth, Madison County, Mont. These mines were bought from J. L. Templemen, who recently purchased them from A. C. Burrage, of Boston. Under the management of W. N. Rossberg, of Butte, 40 men are being employed to open a large deposit of copper-gold ore. This property has been a small producer for some time, a mill having been erected in 1910.

Ardsley Butte Shaft Nears 500 Level

According to reports from the management, Ardsley Butte expects to tap the Highland vein on the 500 level, at its property in the southwest part of the Butte district, within a few weeks. In the meanwhile shipments have been resumed at the rate of 50 tons a day. As soon as ore has been struck on the 500 level, shipments will be started from nine stopes on the three producing levels, it being planned to bring the output up to 300 tons a day. To take care of this production, an Ottumwa hoist with a 250 hp. motor and a new gallows frame are being installed.

Turner Reports on Bureau of Mines Activities to Secretary of Commerce

STUDY of measures for the safeguarding of the lives and health of the more than 2,000,000 workers in the nation's mining, metallurgical, and oil and gas industries formed the major activity of the U. S. Bureau of Mines in the fiscal year 1928, states Scott Turner, Director of the Bureau, in his annual report to the Secretary of Commerce. Increased efficiency in the mining, treatment, and utilization of the country's mineral materials, with products valued at more than $6,000,000,000 annually, also occupied much of the Bureau's attention.

Nearly 50,000 workers in the mineral industries were trained in first-aid or mine rescue methods, by the personnel of the Bureau's mine rescue cars and trucks, establishing a new record in such activities, and bringing the total number trained by the Bureau to approximately 250,000. This training was given in 537 mining, metallurgical, quarrying, and oil-producing communities in 36 states and Alaska.

Health and sanitation problems of the mineral industries were given attention, especially with reference to poisonous gases, unwholesome dusts, and unhealthful conditions of temperature and humidity to which the miner is often exposed. At the Bureau's clinic, at Picher, Okla., about 10,000 Tri-State workers were given physical examinations.

Investigations by the mining division included drilling and blasting, loading ore and coal, mine timbering, breaking and handling ore, mine ventilation, underground transportation, mine sampling methods, and efficiency of mine labor. Special attention was given to geophysical prospecting, that interesting recent development which is making possible the location of hidden mineral deposits. An ever-increasing amount of mineral wealth is being recovered by stripping operations, and the Bureau is studying the efficient use of excavating machinery in open cuts. Subsidence of land after mining operations was given attention, notably in the Michigan metal-mining region. A study of mining methods and costs in coal and metal mines of the principal districts was begun.

In metallurgy, the Bureau continued to contribute to the practical conservation of the nation's mineral resources through development and improvement of methods for recovering more of the mineral content of ores, with attendant lessening of the cost of recovery. Application of flotation to Michigan copper ores was tested during the year, with the promise of substantially increasing the recovery in that district, and reducing production costs.

Further service was rendered by the Bureau in the improvement of treatment of complex or low-grade ores of the Western states, a matter vitally affecting the prosperity of those states. Its experimental iron blast furnace, the only one of its kind in the world, is being used in an effort to recover profitably the manganese content of low-grade manganiferous iron ores in northern Minnesota. The Bureau continued its efforts to assist in the development of commercial supplies of the different essential mineral materials of which the nation does not possess adequate reserves.

Special attention was also given to various metallurgical problems of vital interest to the copper-mining industry and to the improvement of milling practice in the Missouri-Kansas-Oklahoma lead and zinc district.

To stimulate development of domestic potash deposits, and thus relieve the American farmer of foreign control of that essential fertilizer material, the Bureau continued the drilling of test wells in Texas and New Mexico. A number of beds of potash-bearing salts, of varying thickness and value, have been found.

Attention was given to the beneficiation of low-grade bauxite ore in Alabama, Georgia, Tennessee, and Mississippi, and low-grade phosphate ore in Florida. Increasing interest in mica, particularly for radio and electrical equipment, led to a survey of the industry. A study was made of the practicability of substitution of the native yellow, brown and lead ochers and other mineral pigments of Oregon and Washington for such materials imported from various foreign countries.

In addition to studying scientific and technical problems increased attention is being given to economic conditions and problems. This involves the collection and dissemination of statistical data regarding production, consumption, distribution, and storage of essential minerals.

To promote safety and efficiency in mining, the Bureau has prepared what is probably the largest collection of educational industrial motion-picture films in the world. These films explain different steps in production, treatment, and utilization of the essential mineral materials, and illustrate safe methods of mining and preparing minerals. The films are produced through the co-operation of industrial concerns, which bear the entire cost of production. On June 30, 1928, the Bureau had 560 sets of films, aggregating 1,483,000 ft. During the year the films were shown on 9,369 occasions before an estimated attendance of 1,645,000 persons.

Seneca Will Use No. 2 Mill of Lake Milling

SENECA COPPER will use the No. 2 mill at Hubbell, owned by Lake Milling & Smelting, in which it has an interest, when production from its mine in the Michigan copper district is resumed. While development and reopening work is in progress, little attention will be paid to output, although it is expected that several hundred tons will be hoisted daily. No. 1 shaft will be lowered an additional 1,000 ft., with new levels every 100 ft. Additional depth in this shaft should intercept the extension of the rich No. 5 Mohawk shoot, and that mined by Ahmeek in Nos. 3 and 4 shafts, which lie to the southeast. No. 2 shaft will be stripped from the 19 to the 25 level and intervening levels opened. In No. 3 shaft, a new concrete collar will be constructed and levels extended both north and south.

Miami Copper Is Installing Immense Cone Crusher

MIAMI COPPER is installing a new 7-ft. Symons cone crusher at its crushing plant at Miami, Ariz. This is the largest cone crusher made by the Symons company, and weighs 110,000 lb. At present, run-of-mine ore, sometimes as large as 14 in., is broken to about 2 in. This 2-in. material is crushed to $\frac{3}{4}$ in. in the primary rolls and then to $\frac{3}{8}$ in. in the secondary rolls, going from there to the ball mills. If the new cone crusher meets expectations, it will do the work of both gyratory and primary rolls and will consume less power. The cone is being equipped with a 250-hp. motor. A crusher's capacity varies, of course, with the type of rock fed to it, so the new machine's output and power consumption cannot be determined accurately until it has been placed in use. Those especially interested, however, expect that it will crush about 300 tons of Miami ore to $\frac{3}{4}$-in. size per hour.

Speculative Interests Busy in Bolivia

A RECENT communication from a subscriber engaged in professional work in Bolivia indicates that speculation in and development of tin properties still continue. Negotiations for the acquisition of the Huanuni placer property by New York interests are reported to have been successfully concluded. At the San Juan de Vila Apacheta holding, diamond drilling did not disclose large bodies of ore, and the interests conducting that work have apparently decided not to conduct further development. The Centenaro placer, in Uncia, is reported optioned to New York operators.

The Maria tin mine, belonging to Vicente Orlandini E., is reported to be producing 60 tons of 65 per cent barrilla per month. Recent development has disclosed ore of commercial value on the fourth level.

Mount Morgan Mine, in Queensland, Will Be Reopened

By P. B. Prior
Sydney, Australia

MOUNT MORGAN, Queensland's famous copper-gold property, will be reopened by the Sydney syndicate which recently examined the property. Although many of the details of capitalization have yet to be decided on, the total share capital—which has already been underwritten—will probably not exceed $1,250,000 and, because it is felt that many people in Queensland will want to participate, those who are financing the reorganization plan to offer $250,000 worth of the shares in Queensland. To equalize the difference between the production from the mine and the plant capacity, ore from outside sources will be required, possibly from the Cloncurry field.

When it was announced in the summer of 1927 that Mount Morgan Gold Mining was going into liquidation, efforts were made to form a co-operative company of miners, the Queensland government, and private interests to operate the property. At that time the mine was known to contain 8,000,000 tons of copper-gold ore with a gross value of $80,000,000.

The intention of the new company is to proceed slowly at first. Much of the existing plant and organization will have to be readjusted to the new policy of development and exploitation. A considerable amount of the usual development work will of course be unnecessary, since the mine was left in good condition when it was closed.

Mount Morgan, which was found in 1882 and operated continuously from then until 1927, paid almost £10,000,000 in dividends to its stockholders. Production was about 5,000,000 oz. of gold and 125,000 tons of copper.

New Steel Cars Ordered for Utah Copper Railroad

BIDS on 100 steel ore cars, with a capacity of 80 tons each, are being asked by the Bingham & Garfield Railroad, owned by Utah Copper and connecting the mines and mills of that company in the Bingham district. The specifications presented by the railroad call for clasp brakes and straight boxes fastened to trucks for dumping on rotary tipples at the Magna and Arthur mills. This additional rolling stock has probably been made necessary by the recent increase in Utah Copper's output, which is being increased to 60,000 tons a day as compared with 40,000 before the recent rise in the copper price.

Burma Corporation Strikes Shan Lode on No. 8 Level

Cable reports received from the properties at Bawdwin, Northern Shan States, Upper Burma, indicate that the Shan Lode has been struck on the No. 8 level, 688 ft. north of the shaft, according to D. Anderson, London secretary of the Burma Corporation. The orebody averages from 5¾ to 13 ft. in width and assays 27.2 oz. of silver, 31.4 per cent lead and 5 per cent zinc. These assay are considerably higher in lead and silver than the general estimate for the mine as last made.

Metals Recovery Appeals Anaconda Decision

ON NOV. 12, 1928, the Metals Recovery Company appealed from Judge Bourquin's decision in the infringement of its Perkins patent, in which the use of xanthate was involved. The decision favored Anaconda Copper as against the Metals Recovery. The case on appeal before the U. S. Court of Appeals at San Francisco was submitted partly by oral argument and partly by briefs. W. H. Davis, of New York, was attorney for the Metals Recovery case and Charles Neave, also of New York, represented Anaconda.

Brazilian Iron Ore Contract Is Indorsed

A contract whereby the Itabira Ore Company, Ltd., has agreed to mine 3,000,000 tons of iron ore annually has been signed by President Washington Luis of Brazil. The deposits are situated in the State of Minas Geraes. Of the ore mined, at least 5 per cent must be smelted in Brazil, according to the contract. The company, which is financed partly by Americans, has plans for the expenditure of approximately $70,000,000 in development work. An article on the iron ore resources of Brazil by Emilio Teixeira appeared in the Nov. 5, 1927, issue of *E.&M.J.*

Columbia Section Meets at Kellogg on Nov. 9

ON NOV. 9, the Columbia section of the A.I.M.E. held an interesting session at Kellogg, Idaho, as the guests of Bunker Hill & Sullivan, with Stanly Easton, manager of that company, acting as host. During the afternoon the visitors were taken through the new Sullivan electrolytic zinc plant. At 6:30 a dinner was served in the Kellogg Y. M. C. A. banquet hall.

After the dinner, Mr. Easton welcomed the members of the section and introduced F. Cushing Moore, president of the Columbia section, who acted as chairman for the evening. R. S. Handy, mill superintendent for Bunker Hill & Sullivan, delivered an address on his experiences in Bolivia, where he recently was engaged in mill construction. E. R. Crutcher, metallurgist at the electrolytic zinc plant, presented a detailed study of the process used, tracing the ore from the concentrator through its five stages in the plant until it came out as 99.99 per cent zinc. The closing speaker was U. C. Tainton, inventor of the electrolytic process used in the plant, who gave some intimate glimpses of his early endeavors in chemistry in South Africa, where he attended college. About 105 members attended the meeting.

North Butte Receivership Is Ended—Mines Opened

Judge George Bourquin has ended the receivership of North Butte Mining, which has been the subject of several suits and countersuits since June, 1927, and the mines in the Butte district are being reopened. The company raised more than $1,000,000 by a reorganization plan, proposed by Paul Gow, president and general manager of the company. About 200 men are now employed at the mines and this number will be increased to 2,000 it is said.

Two Tri-State Properties Are Optioned

Dorothy Bill Mining has taken a drilling option on the Dobson lease of Federal Mining & Smelting, near Hockerville, Okla., in the Tri-State district. Several drill rigs are being operated on the property, and results are said to be favorable.

F. W. Evans has optioned the Donna Jane mine, in the east Oklahoma field, and has put several drills on the tract. The mine was last operated by Frank Childress and associates.

North Lily Active

Production from the North Lily mine of International Smelting, in the Tintic district, Utah, is averaging 200 tons of silver-lead ore daily. The company is raising on a 7-ft. orebody in the quartzite formation on the 700 level to reach the overlying Ophir limestone formation.

Lead Interests Organize to Promote Industry's Welfare

A LEAD Industries Association was formally organized Nov. 14 at the Roosevelt Hotel, New York, by leading lead mining, smelting, and manufacturing companies. In general the association intends to promote the serviceability of the lead industries to the community at large, and will parallel some of the activities of existing organizations in other non-ferrous metal industries. The association also expects to disseminate accurate information regarding the use of lead products; to collect statistical information relating to the production, distribution, marketing, and consumption of lead and lead products, and to develop methods for improving the welfare of those engaged in the lead industries.

Membership in the Lead Industries Association will comprise corporations interested in the mining, smelting, or manufacturing of lead in the United States, Mexico, Canada, and South America. Among these companies are Ahumada Lead Company, American Lead Company, American Metal Company, Andrews Lead Company, American Smelting & Refining Company, Bingham Mines Company, Bunker Hill & Sullivan Mining & Concentrating Company, Cerro de Pasco Copper Corporation, Chief Consolidated Mining Company, Consolidated Mining & Smelting Company of Canada, Ltd., Eagle-Picher Lead Company, El Potosi Mining Company (Howe Sound Company), Evans-Wallower Lead Company, Federal Mining & Smelting Company, Federated Metals Corporation, Fleck Brothers Company, W. P. Fuller & Company, General Cable Company, Glidden Company, Hecla Mining Company, Johnston Tin Foil & Metal Company, Day interests (Idaho), Metals Refining Company, National Lead Company, Northwest Lead Company, Park Utah Consolidated Mining Company, Remington Arms Company, Sherwin-Williams Company, Silver King Coalition Mines Company, St. Joseph Lead Company, Tintic Standard Mining Company, Utah-Apex Mining Company, Utah Copper Company, United Metals Selling Company, U. S. L. Battery Corporation, U. S. Smelting, Refining & Mining Company.

The following officers of the association were elected at the meeting: Clinton H. Crane, who is president of St. Joseph Lead Company, president; Hamilton M. Brush, who is vice-president of American Smelting & Refining Company, and Ralph M. Roosevelt, who is vice-president of Eagle-Picher Lead Company, vice-presidents; Felix E. Wormser, mining engineer, secretary-treasurer.

Directors of the new association include the following: C. M. Loeb, Hamilton M. Brush, Stanly A. Easton, C. V. Drew, W. S. Rugh, R. M. Roosevelt, R. M. Evans, Ivan Reitler, G. W. Lambourne, Edward J. Cornish, Frank Norvell, Clinton H. Crane, John A. McCarthy, A. A. MacLean, and F. Y. Robertson.

Four Nevada Quicksilver Districts Expected to Be Large Producers

High Prices for Metal Stimulate Activity at Antelope Springs, Fish Valley, Cinnabar Mountain, and Beowawe—Several Other Districts Are Contributing to the Output

By Walter S. Palmer
Mackay School of Mines, University of Nevada, Reno, Nev.

PROSPECTING for quicksilver in Nevada has been greatly stimulated during the last two years by the rise in the price of the metal. Many new deposits have been found, and some of them have developed into producing mines. There are today at least 69 known occurrences of cinnabar in Nevada. The deposits are widely scattered over the state, and it is probable that at least one occurrence is found in each county. The largest mineralized district in the state is an area of rhyolite north of Battle Mountain which covers about 27 square miles. The Antelope Springs district, about 25 miles southeast of Lovelock, is at present the chief producing district in the state. The two principal properties in this district are the Nevada Quicksilver Company, locally known as the Friedman property, and the Pershing Quicksilver Company, known as the Adamson property. Both of these mines are equipped with Gould rotary furnaces. At the Friedman property, a 3x40-ft. furnace is used. The Adamson property is equipped with a 4x60-ft. furnace. In addition to the rotary furnace the Adamson company has recently installed a multiple hearth furnace of the Herreshoff type for treating fines. At both of these properties cast-iron retorts were first used on the high-grade ore. There are several other prospects in the district, which covers in all several square miles, the two principal properties being about 2½ miles apart.

Several Properties Operating in Fish Lake Valley

The second district in importance is known as the Fish Lake Valley district, and is in the White Mountains in Esmeralda County, about 12 miles from Basalta station on the Owens Valley branch of the Southern Pacific Railroad. There are several properties in this district, but the most important is that of the B & B Quick Company. This company recently installed a 50-ton rotary furnace of the Cottrell type. It is 5x50 ft. in size. Other properties in the district have installed cast-iron retorts and are treating high-grade ore.

The district near Beowawe will probably be the third important district from a production standpoint within a month. Nevada Mexico Mining Corporation is completing a plant which will use a 3x40-ft. Gould rotary furnace. The condensing system will consist of metal condensers with redwood tanks for settling chambers. Electric power will be supplied from a generator operated by a Fairbanks-Morse Diesel engine.

East of Mina, in the Pilot Mountains, several properties have been located on what has been called Cinnabar Mountain and have become small producers, treating high-grade ore in cast-iron retorts. Nevada Almaden Quicksilver is probably the principal producer. This company is reported to have 35,000 tons of 1.4 per cent ore developed. Production was 60 lb. of quicksilver per day from high-grade ore, according to the most recent report.

Flotation of Quicksilver Ores Will Be Tested

Cinnabar has long been known to be one of the minerals being deposited from the hot waters at Steamboat Springs. There is a deposit of cinnabar west of the springs in disintegrated granite. This was first located in 1875 and was worked for a short time in 1877. Recently the property was taken over, and plans have been made to develop the deposit. It is claimed by the management that a large tonnage of better than 4-lb. ore is available and that tests have shown that it can be successfully treated by flotation. The concentrate is to be treated in Johnson-McKay retorts. If this method proves successful the operation will be the first example of quicksilver ore flotation in the state. The management expects to obtain a 95 per cent recovery and to treat ore averaging 1 lb. of quicksilver per ton at a profit. An interesting point in the proposed treatment is to eliminate 50 per cent of the material by classification before flotation is applied. Foundations are now being prepared for a 300-ton mill.

Treadwell Yukon has acquired a property in northern Humboldt County in which cinnabar occurs as a placer deposit in a small basin, about 500 ft. in diameter. A large tonnage of furnace ore is reported. No treatment scheme has as yet been made public. Other camps where some quicksilver is being produced are as follows: Manhattan, Round Mountain, Belmont, Ione, Summit Springs, Secret Basin, Rochester, Gerlach, Castle Peak, and Midas.

The staff of the Mackay School of Mines is now gathering material for a bulletin on quicksilver in Nevada, to be issued in 1929, which will cover the various properties, their geology, methods of mining and metallurgy. Many new pieces of apparatus and schemes of treatment are being tried out in the state. It is hoped that by spring they will have been subjected to test long enough to make possible a summary of the results obtained for the benefit of all operators.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Mount Isa Directors Issue Statement on Progress in Diamond Drilling

Melbourne, Oct. 24, 1928.—To enable shareholders in Mount Isa Mines, Ltd., to follow the results of diamond drilling on the company's property in Queensland, the directors have issued a summary of drilling to date, and diagrams of the sections being tested. The outcrop on the Black Star lode is approximately 2,000 ft. long, and varies from 100 to 300 ft. wide. The ore proved to a depth of 600 ft. is estimated by the management as 9,000,000 tons of sulphides, assaying 6 per cent lead, 8 per cent zinc, and 4 oz. of silver to the ton, and 3,800,000 tons of carbonates, assaying 9.3 per cent lead and 2.5 oz. of silver a ton. Drilling below the 600 level is proceeding.

THE FOOTWALL of the main orebody has been tested with results which directors claim may be taken as indicating the existence of several parallel veins of ore. Five holes on the Rio Grande lode have entered richer ore than that encountered on the Black Star, although it is not so wide. The hanging wall of the Black Rock lode having proved difficult for diamond drilling, work on it has been stopped.

Construction of a dam to hold 600,000,000 gal. is expected to be completed next autumn, and the railway line from Duchess should reach Mount Isa about the end of the year. The directors add that the milling and smelting plants to treat both carbonate and sulphide ores will have an initial capacity of 2,000 to 2,500 tons daily. Experiments have given recoveries exceeding 90 per cent of the assay results. Designs are being prepared and orders for equipment have been given.

The Australian Shale Oil Company some time ago erected a Bronder retort on its Tasmanian leases, but, because of financial and other reasons, operations have been suspended.

English interests which hold options over the Guinea Gold Company's leases in New Guinea have secured an extension of the option until June, 1929, by the payment of £2,000. A. Dickinson, mining engineer, of London, is now on the field to test the ground.

A promising discovery of gold was made at Moliagul in the Dunolly district, Victoria, early in October by a party of road contractors. Within five days more than 400 oz. was obtained in sinking to a depth of 12 ft. The district is famous for its rich nuggets, as it was near Mount Moliagul that the large "Welcome-Stranger" nugget was discovered. The find is interesting, but the irregular occurrence of the gold hardly warrants forming companies.

The Latest in Electrolytic Zinc Practice

THE new Sullivan zinc plant, owned jointly by Bunker Hill & Sullivan and Hecla Mining, is in successful operation. *Engineering and Mining Journal* is privileged to present the details of design and operation of an installation that has created wide interest, both on account of its metallurgical and economic efficiency and also because an exceedingly high grade of zinc is produced — above 99.99 per cent. The account, by Mr. U. C. Tainton, is scheduled to appear in next week's issue.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Amulet Decides to Build Mill and to Start Production Early Next Summer

Toronto, Nov. 17, 1928—The management of Amulet Gold, operating in the Rouyn district, Quebec, has definitely decided to construct a concentrating plant with a 200-ton capacity as soon as possible, with the hope of starting productive operations early next summer. It is believed that no new financing will be needed for mill construction. The ore contains copper, zinc, silver, and gold, with zinc accounting for about one-half of the total metallic content. An official of the company is arranging a market for the zinc concentrates in Belgium, as there is no zinc-smelting plant in eastern Canada. Copper concentrates will be sent to the Noranda smelter.

AN ELECTRICALLY driven mining plant is being installed at Ritchie Gold, in the Kirkland Lake district. Operations will begin in December. Plans call for sinking to a depth of 1,500 ft., although the plant is capable of working to 2,000 ft. The decision to sink follows a diamond-drilling campaign over a length of a quarter of a mile.

The shaft at Falconbridge Mines is now down below 125 ft. at the property in the Sudbury district. Erection of the headframe is under way and should be completed within a month. Shaft-sinking operations have been hampered by the fact that power has been supplied by a small gasoline engine up to the present. However, machinery for an electrical plant and a compressor is being delivered to the property.

Mexico City Letter

By W. L. Vail
Special Correspondent

Commission to Discuss Labor Law Meets—Acceptance of New Provisions Is Likely

Mexico City, Nov. 12, 1928.—The mixed commission to discuss provisions of the new labor law, as proposed by the incoming president of the republic, Portes Gil, is now in session in this city. The commission is composed of representatives of various mining and industrial concerns throughout the country, as well as representatives of all branches of labor. The plan proposed for the modification of Article 123, which relates to labor, is practically the same as the one drafted by the late president-elect, General Obregon, a short time before his assassination. This plan is considered by the majority of the mining and industrial firms to be extremely drastic, and, in some respects, quite impractical. In addition to the provisions for changing the law, there is a new amendment on labor insurance which would be a large item in the budgets of mining and industrial companies. It seems almost a certainty that the new administration intends to force its views through the present congress before adjournment in December.

INCOMPLETE data regarding mineral output for the first ten months of the year, up to Nov. 1, indicate a general increase over the 1927 figures. Silver seems to be more than holding its own as well as lead, in spite of lower prices for the latter, and copper and quicksilver figures should show increases. Most of the new activity has been in the northern states, where a number of new properties have been opened up and put into production.

The list of exhausted mines continues to grow. The latest addition is the El Cristo mine, owned by Santa Gertrudis, the Mexican subsidiary of Camp Bird. For the last two years this property, which is in the Pachuca district, State of Hidalgo, has been steadily curtailing work and economizing, but apparently the end is in sight. In the same district the Guadalupe y Anexas property, which was closed down for several weeks because of trouble with its power plant, is preparing to resume operations.

From Guerrero comes the report that the Puerto Corral, a small mine near the border of the State of Mexico, has installed a flotation plant which is expected to be in full operation early in December. This is one of the few properties now operating in Guerrero.

Lead shipments from Tampico have risen considerably, whereas there has been a marked falling off in zinc shipments. For the week ended Nov. 3, 95 carloads of lead, 86 carloads of zinc, 10 of copper, 3 of arsenic, and 1 of antimony were exported.

MARKET AND FINANCIAL NEWS

November Dividend Disbursements at Record Rate

By Homar L. Johnson
Assistant Editor

DIVIDENDS paid by American mining companies this month constitute a new November record. The November totals in each of the last four years compare as shown in the accompanying tabulation:

	November Dividend Total	*E.&M.J.* Weighted Metal Price Index
1925	$14,261,202	116.69
1926	15,216,322	104.21
1927	17,846,584	96.22
1928	19,247,397	(*a*)103.

(*a*) Estimated.

A reference to the corresponding number for *Engineering and Mining Journal's* Weighted Index of Non-Ferrous Metal Prices indicates that the consistent improvement shown in dividend disbursements is not attributable to a corresponding upward tendency in metal prices in general, with the possible exception of the 1928 figures. However, though the 1928 improvement over 1927 is relatively constant in both columns, the fact remains that the 1928 dividend figure is 35 per cent above the 1924 figure. The corresponding 1928 metal price index number is lower by approximately 13 per cent than it was in 1924. A complete explanation of this improvement must take into consideration several factors, among which the following are important: (1) Earnings during the period of high metal prices in 1924, 1925, and early 1926 did not go directly into dividend payments, but were added to reserve funds and, in many instances, invested in plant or equipment improvements that were not immediately reflected in either higher earnings or dividend rates; (2) numerous operating economies have been effected since the decline in metal prices set in that, in many instances, have served to offset appreciable reductions in price levels; (3) each successive year since the post-war deflation of 1920 and 1921 has seen the better managed companies building their financial structure upon firmer foundations and there has been less tendency to dissipate current earnings in dividend disbursements without ample surplus reserve fund backing—this tendency probably was increasing until 1925, since when advantage has been taken of the more adequate financial reserves to permit increased dividend payments; (4) the larger number of investment trusts and holding companies, the existence of overlapping financial structures of subsidiary and operating companies has tended to increase the dividend total reported by *Engineering and Mining Journal* through duplication.

Though this month's total exceeds the November, 1927, total by $1,402,813, it is $619,232 less than the total for the preceding quarter month—August—of this year. A comparison of dividend totals in the second month of each quarter during the past two years is shown in the accompanying tabulation:

	1927	1928
February	$16,137,913	$17,797,953
May	16,564,931	17,359,998
August	16,965,732	19,866,615
November	17,846,584	19,247,397
Total	$67,515,510	$74,271,977
Average	16,878,890	18,567,994

Influencing factors in the decline of the dividend total reported this month as compared with the August, 1928, total are: (1) A decrease in Freeport Sulphur's quarterly extra payment from $1.75 to $1.25 per share; (2) Lone Pine-Surprise Consolidated, operating in Ferry County, Wash., reported a semi-annual disbursement in August, and none this month; (3) Utah-Apex made an irregular distribution from surplus capital in August that is not matched in the November list; (4) Teck-Hughes reported a semi-annual and extra payment of 30c. per share in August, but reverts to a regular quarterly basis of 15c. per share this month; (5) Hollinger's decreased monthly dividend rate—from 10c. to 5c. per share—effective in October, likewise lessens the November total as compared with August; (6) and a monthly dividend for July of Lucky Tiger-Combination was added to the August total, as it was reported too late for inclusion in July. This latter item is partly offset, however, by a dividend of the Sunshine Mining Company, Coeur d'Alene producer, which was paid in October, but was not reported in time for inclusion in the October list, and, as a result, appears in the November tabulation.

The fact that copper producers, in general, have established substantial financial structures is indicated by the rapidity with which they have been able to reflect higher earnings, resulting from the recent improvement in the copper situation in augmented dividend payments. Speculation is rife in financial circles just now as to the identity of the next copper producer to announce an increase in its dividend rate. The latest to be stepped up were Kennecott's quarterly rate from $1.50 to $2; Calumet & Hecla's from 50c. to $1, and Chile Copper's from 62½c. to 75c. per share; Kennecott's payable in January and the others in December. Andes Copper enters the list of dividend payers with an initial "special" disbursement of 75c. per share announced for December payment, also.

E. & M. J. Compilation of Mining Dividends and Yields for November, 1928

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Smelting & Refining	Various	$2.00 Q	$1,219,960	3.1
Anaconda Copper, c, z, l, s$_s$	Various	1.00 Q	3,000,000	4.2
Bunker Hill & Sullivan, l, s	Idaho	0.75 MX	245,250	6.7
Colorado Fuel & Iron, pfd	Various	2.00 Q	40,000	....
Freeport Texas, su	Texas	1.25 QX	913,235	13.2j
Homestake Mining, g	S. D.	0.50 M	125,580	8.8j
Miami Copper	Ariz.	0.375 Q	280,168	5.6
National Lead, pfd. "B"	Various	1.50 Q	375,000	5.1
New Cornelia Copper	Ariz.	0.50 Q	900,000	4.8
New Jersey Zinc	Various	2.00 Q	981,632	5.2j
Sunshine Mining, s, l, z	Ida.	0.02 Q	20,000	6.2
U. S. Steel, pfd	Various	1.75 Q	6,305,497	5.0
United Verde Copper	Ariz.	3.00	900,000	....
United Verde Extension, c	Ariz.	0.50 Q	525,000	8.5
Vanadium Corporation	Various	0.75 Q	283,775	3.9j
Companies in other countries				
Amparo Mining, g, s	Jalisco	0.01 Q	20,000	4.3j
Cerro de Pasco, c, s	Peru	1.25 Q	1,403,553	4.9
Granby Consolidated, c	B. C.	1.00 Q	444,605	4.9
Hollinger Consolidated Gold	Ont.	0.05 FW	246,000	13.4j
International Nickel, pfd., n, c	Ont., W. Va.	1.50 Q	133,689	4.8
Lucky Tiger-Combination, g, s	Sonora	0.05 M	33,302	11.9j
Teck-Hughes, g	Ont.	0.15 Q	713,571	6.8
Wright-Hargreaves (new), g	Ont.	0.025 Q	137,500	5.9j
Total			$19,247,397	

c, copper; z, zinc; l, lead; s, silver; g, gold; n, nickel; su, sulphur; Q, quarterly; M, monthly; MX, 25c. monthly and 50c. extra; QX, $1 regular and $0.25 extra; FW, four weeks; j, based on dividends for the last 12 months.

Survey of World Zinc Conditions

By International Metal Service, London Foreign Correspondent of American Zinc Institute

WORLD zinc production for 1928 is shaping for a total of 1,390,000 metric tons, which is substantially ahead of the 1927 output of 1,329,000 tons. What a different story we should have to tell today had there been the same voluntary curtailment in the production of zinc as has been practiced in the production of lead. Though zinc will show an *increase* of 61,000 metric tons this year, the output of lead will in our estimation register a *decrease* of 64,000 tons. The result is that the lead industry has just reached that point when a steady improvement in the statistical position can be expected, whereas the zinc industry is still suffering from overproduction, coupled with the fear that output will expand next year to a further extent beyond consumptive needs.

That the producers need have curtailed zinc production only moderately this year is apparent from a glance at world stocks. These in ten months have only grown by approximately 14,000 tons, which in turn proves that the bulk of the enhanced production has passed readily into consumption. Had, therefore, producers agreed among themselves to voluntarily "cut" output to the trifling extent of 5,000 tons a month, the statistical situation at the present time would have been strong in the extreme and the market would not have remained in the doldrums.

With various new plants operating, approaching completion, and planned, it is more necessary than ever for the producers of the world to get together for the purpose of bringing about rectification. That surely ought to present no insuperable difficulty today, having regard to the fact that the European smelters are members of a cartel and can thus talk with one voice with the American Zinc Institute as representative of the smelting interests in North America.

At time of writing hopes are centered upon an understanding being reached at the next conference in Brussels, whereby American interests will agree in principle to a revised proposal to be submitted to them and thus permit of the present European Zinc Cartel being converted into a powerful organization of worldwide scope. Given such an outcome, zinc would enter upon a new era with results perhaps in time as happy as in the 1928 history of copper.

Belgium has taken the leading part in this new organization, and German smelters have now fallen into line in approving the steps taken by the Belgians for widening the scope of the cartel by inclusion of Australian, Canadian and United States interests. The Belgian zinc industry has perhaps more to gain than the German or the French industry, where the entire domestic production is fabricated locally. In Britain, also, the combined output of the home smelters is required for domestic consumption; indeed, the annual production of 55,000 metric tons is but a small proportion of the zinc consumed in Great Britain. But, as we have emphasized on so many occasions, the zinc-smelting industry in England is unlikely to assume a position of importance in terms of world production, and will need some kind of protection to be maintained even at its present level after June, 1930, when the arrangement whereby it is provided with Australian concentrates by the British Board of Trade on ultra-favorable terms expires.

To yield a reasonable return upon the capital invested, a higher selling price is as necessary to the majority of producers in the United States as elsewhere; thus, the sooner the world situation is regulated and established on such a footing that production is strictly limited to consumptive needs the better for everyone concerned. The accomplishment of that end requires such a slight trimming of output, if carried out internationally, as to create a minimum of embarrassment to the individual producing companies or states. In such discussions the principal issue will be the increasing production of High-Grade zinc.

We estimate world stocks of zinc on Nov. 1, 1928, as follows:

	Metric Tons
United States	41,800
Canada	4,300
Germany-Poland	5,500
Belgium	6,200
France	700
Great Britain	700
Other Europe	1,000
Australia	4,200
Far East	800
Elsewhere	2,000
Total	67,200

Great Britain Consumes More Metal

BRITISH consumption of copper, tin, and zinc during the first six months of 1928 showed an increase over that for the corresponding period of 1927, though the total increase for the three metals was almost balanced by a decline in the consumption of lead, according to the U. S. Department of Commerce.

Statistics issued by the London Metal Exchange show that during this period the apparent consumption of copper increased 5 per cent, tin 6 per cent, and zinc 3 per cent, whereas the use of lead declined 8 per cent.

Copper ore imports during the first half of 1928 came to 109,730 tons, compared with 96,057 tons and 87,471 tons for the corresponding periods of 1927 and 1926, respectively. The 1928 importation was divided into 21,798 tons of ore, including regulus and matte; 78,612 tons of bars and blocks and 9,320 tons of plates, sheets, and similar forms. During July and August of this year there was a still further increase in the imports of copper ore, total imports for the eight months standing at 32,878 tons, compared with 23,654 tons in the January-August period of 1927. Exports and re-exports of copper products and concentrates during the first six months of 1928 totaled 38,996 tons, compared with 43,406 tons in the first half of 1927 and 35,921 in the first half of 1926.

Of all the major non-ferrous metals, tin shows the greatest increase in consumption of 1927, a fact which was the result, probably, of increased activity in the British tin-plate trade. During the first eight months of the present year British exports of tin plates totaled 367,453 tons, compared with 324,924 tons in January-August, 1927. Another interesting feature of the tin industry is that during the first half of 1928, of the total world supplies of tin, 65.7 per cent was produced and smelted in the British Empire, against 63.1 per cent in the first half of 1927. At the same time, 24.3 per cent of the total world supplies were produced in foreign countries, but smelted or refined within the Empire, compared with 22.7 per cent in 1927. Thus the quantity of tin produced and smelted in non-British countries declined during the year from 14.2 per cent of the world's total to 10 per cent.

With regard to zinc, though the statistics of the Metal Exchange show an increase in consumption this year over last, it seems probable that there was actually a decrease in consumption in Great Britain, the apparent increase being probably due to the inclusion in current statistics of the production of one maker not included in preceding years. This caused the recorded production to rise from 14,796 tons in the first half of 1926 and 19,784 in the first half of 1927 to 27,005 in the first half of the present year, causing the total supply available to rise from 89,604 tons in the first half of 1926 and 95,961 in January-June, 1927, to 98,041 tons in the first six months of 1928. This is in spite of a decline of imports from 75,255 tons in January-June, 1927, to 70,357 in the corresponding months of the present year, and of the fact that stocks of 679 tons on hand at the beginning of 1928 were smaller than those at the beginning of 1927. Exports during the six months and stocks at the end amounted to 4,938 tons and 1,236 tons respectively, both somewhat smaller than corresponding figures for 1927, the total of 6,174 tons comparing with 6,866 tons of exports during the first half of 1927, plus stocks at the end of that period.

KEELEY SILVER MINES, during the three months ended Oct. 31, 1928, produced 151,226 oz. of silver and 19,935 lb. of cobalt. Exploration of the lower contact is reported as progressing satisfactorily and interesting occurrences of cobalt and leaf silver have been encountered. It is anticipated that the most favorable ground will be reached in from two to three months' time.

MAGMA COPPER, during the third quarter of 1928, produced 9,376,448 lb. of refined copper at a cost of 9.04c. per pound after deducting gold and silver credit and depreciation charges but before federal tax allowance. Net earnings for the period, before federal tax deductions, were $551,944.

Nevada Cons. Makes Favorable Report for Third Quarter of 1928

THE report of Nevada Consolidated Copper covering the combined results of operations in Nevada, Arizona and New Mexico for the third quarter of 1928 is indicative of the benefits derived by some of the copper producers from the recent price advances and the higher rate of consumption now prevailing.

The net production of copper from all sources for the third quarter, compared to that for the two preceding quarters of 1928, is shown in the following tabulation, in which figures represent pounds:

1928	Copper Produced
Third quarter	70,951,942
Second quarter	63,707,374
First quarter	52,576,896

The total quantity of company ores milled and smelted during the quarter was 2,994,727 tons. Of this total 2,969,676 tons was concentrating ore, averaging 1.407 per cent copper, and 25,051 tons was direct smelting ore. In addition, 193,107 tons of custom ore was milled or smelted at the Nevada plants. The average daily tonnage of company ores milled at all concentrators was 32,279, compared with 30,698 tons per day for the preceding quarter.

The average recovery in the form of concentrates from company material milled during the period was 86.06 per cent of the total copper contained therein, corresponding to 24.21 lb. of copper per ton treated, as compared to a recovery of 87.07 per cent and 23.20 lb. per ton for the previous quarter.

Net cost per pound of copper produced, after crediting revenue from gold and silver and other miscellaneous earnings and income from subsidiaries, was 7.89c., compared with 8.48c. for the second quarter of the year. These costs include all operating and general charges of every kind except depreciation and reserve for federal taxes.

The financial results of the quarter's operations, compared with those for the preceding quarters of the year, are shown below:

	Third Quarter	Second Quarter	First Quarter
Operating profit from copper production	$4,371,515	$3,214,654	$2,180,654
Value of precious metals	389,969	333,233	266,127
Miscellaneous revenues, including income from subsidiaries	308,471	312,710	251,539
Total operating income	$5,069,956	$3,860,598	$2,698,322
Depreciation	420,260	420,260	420,260
Net income	$4,649,695	$3,440,337	$2,278,061

Statistical Notes

ANDES COPPER MINING COMPANY has called its convertible 7 per cent debenture bonds for redemption at $110 on Jan. 1, 1929. The bonds may be converted into common stock at the rate of 44 shares of stock for each $1,000 of debenture bonds any time before the redemption date.

BURMA CORPORATION, LTD., reports 34,990 tons of ore mined during September. Refinery products were 6,666 tons of lead and 604,230 oz. of silver. A total of 750 tons of copper matte was produced from the treatment of accumulated smelter byproducts and 4,780 tons of copper ore. Zinc plant produced 4,700 tons of zinc concentrates, assaying 10.5 oz. silver per ton, 6.9 per cent lead, and 50.6 per cent zinc.

FREEPORT TEXAS COMPANY reports net earnings for the quarter ended Aug. 31, as $680,962. Net earnings for the last three quarters total $1,952,393. Production during the period from Jan. 1 to Oct. 18, 1928, was 722,210 tons, which compares with 641,560 tons during the corresponding period of 1927.

VIPOND CONSOLIDATED MINES, LTD., during the three months ended Oct. 31, 1928, produced bullion to the value of $179,800 from 23,013 tons milled. Developments on the 600 and 700 levels as outlined at the annual general meeting of shareholders held on Nov. 6, continue to show excellent results, and work has been started on the 500 level with a view to finding the upward extension of this orebody.

UNITED VERDE EXTENSION MINING COMPANY has entered into an agreement with American Metal and Newmont Mining whereby it secures a one-third interest in a joint option on the property of the Cape Copper Company in Namaqualand, South Africa. Officials of U.V.X. state that some high-grade ore and a considerable tonnage of concentrating ore is now in sight at the Cape property, and that if the present active development campaign discloses sufficient additional ore, a considerable expenditure for plant and equipment will be made to make the property a profitable producer.

NATIONAL METAL CORPORATION has been organized under the laws of Delaware to acquire, operate, and manage mining and metallurgical enterprises in the Tri-State district. The new company initially acquired the assets and property of the Missouri-Kansas Zinc Corporation. National Metal and its subsidiaries will have no funded debt, preferred stocks, or other prior liens, and the authorized capital will consist of 500,000 shares, of which 133,530 are to be issued. The corporation will be under the same management as the Missouri-Kansas Zinc Corporation with several additional interests represented on the directorate. It will own in fee or control under long-time operating leases 340 acres of mineral lands, and negotiations are said to be progressing for the acquisition of additional properties comprising 738 acres.

Tariff Status of Glass Sand Under Review

LITIGATION is under way to determine whether sand destined for glass manufacture should be classified as sand or silica. Ordinary sand is not dutiable, but imports of crude silica can be assessed at $4 per ton under the tariff act. Belgian glass sand has been, at different times, under both categories. After allowing it to come in on the free list, the Bureau of Customs ruled that it pay duty as silica. Later the bureau was about to reverse this decision and take off the duty when the Nevada Silicon Corporation filed an injunction in the Supreme Court of the District of Columbia to prevent the Treasury and bureau officials from so doing. This is said to be the first action of its kind ever taken in a customs case. The bill of complaint was dismissed Oct. 30, but is being taken up in the Court of Appeals. If the lower court is sustained, the duty will, it is expected, be removed. It is understood that Belgian glass sand will compete with the American product if freed from the $4 customs charge.

Value of Mica Imports During First Half of 1928 Declines

IMPORTS of crude mica into the United States during the first half of 1928 showed an increase of 6.3 per cent in quantity over those for the corresponding period of 1927, accompanied by a decrease of 26 per cent in valuation, according to the minerals division of the U. S. Department of Commerce. Though the decline in average value of imports has been general for all classifications of crude mica, the greatest decrease occurred in mica splittings.

During the first six months of this year, this country imported 245,875 lb. of unmanufactured mica, valued at $121,016, as compared with 366,183 lb., valued at $243,152, in the like period of last year, and imports of mica splittings were 1,525,950 lb., valued at $452,428, as compared to 1,300,937 lb., valued at $530,325, in 1927. India predominates as a source of unmanufactured mica.

Swedish Sulphur Imports Decline

SWEDISH imports of sulphur and pyrites have been affected by the labor conflicts in the pulp industry during the first four months of 1928, according to a report made public by the U. S. Department of Commerce. Shutdowns of numerous plants employing sulphuric acid in their process resulted in a fall in imports of sulphur to 10,290 metric tons in the first half of 1928, compared with 22,850 tons in the corresponding months of 1927. The trade in pyrites was not influenced by the labor conflicts to such an extent as sulphur, receipts declining from 54,475 tons to 48,551 tons. The United States supplies the bulk of the sulphur imported and Norway and Spain the pyrites.

Utah Copper's Income for Third Quarter Increased 32 Per Cent

FEATURES of Utah Copper's report for the third quarter of 1928 are an increase in total income amounting to $1,841,177, or 32 per cent; and an increase in copper production of 11,125,225 lb., or 18 per cent, over results reported for the second quarter of 1928.

The total net production of copper from all sources for the quarter, in comparison with the output for the two preceding quarters of the year, is as follows, in pounds:

1928	Copper Produced
Third quarter	71,716,464
Second quarter	60,591,239
First quarter	55,604,174

During the quarter the Arthur plant treated 2,071,500 dry tons of ore and the Magna plant 2,102,800 dry tons, a total for both plants of 4,174,300 tons. This indicates operation at the rate of approximately 46,400 tons per day at the two plants. The reported increase in tonnage to 60,000 tons per day late in the last quarter should have considerable to do with increasing earnings and output further during the fourth quarter.

The average grade of ore treated at the mills was 0.99 per cent copper and the average mill recovery of copper in the form of concentrate was 88.89 per cent of that contained in the ore, as compared with 0.97 per cent copper and 89.50 per cent recovery, respectively, for the previous quarter.

The average cost per pound of copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 6.1c. as compared with 7c. for the preceding quarter, computed on the same basis.

Dividend disbursements during the quarter ended Sept. 30 were at the rate of $2 per share, an increase of 50c. per share over the $1.50 payment previously in effect.

The following tabulation shows the financial results of operations for the quarter as compared with the previous quarters of the year:

	Third Quarter	Second Quarter	First Quarter
Net profit from copper production	$5,871,357	$4,284,505	$3,401,720
Miscellaneous income, including gold and silver	884,670	680,345	566,094
Income from investments	832,631	782,631	857,631
Total income	$7,588,659	$5,747,482	$4,825,446
Depreciation	335,405	312,160	309,226
To surplus	$7,253,253	$5,435,321	$4,516,220

Paymaster Stockholders Assessed

UNITED Mineral Lands Corporation, operating the Porcupine Paymaster mine, in northern Ontario, has made a seventh assessment on its stock. The assessment is 10c., payable in four equal installments on Oct. 24, Dec. 8, Jan. 22, and March 8. With the notice of the assessment shareholders are receiving a report covering operations up to the end of September. Notice is also given of the intention to change the company to a non-assessable structure and to reduce the capital. These measures have passed the board of directors, and a meeting of stockholders will be called to consider the proposals. The directors feel that this change will relieve stockholders from future financial effort to bring the mine to profitable operation.

The mill treated 7,384 tons of ore in June, 8,502 tons in July, 8,630 tons in August, and 9,719 tons in September. Income from milling in those months was $11,783, $8,961, $11,955, and $17,014, respectively. Expenses were $54,089, $40,318, $38,146, and $35,147 respectively.

After deducting revenue from rents and miscellaneous sources, and adding capital charges of $14,025, $1,708, $3,429, and $1,369, respectively, expenses exceeded income in June by $56,618; July $40,318; August, $29,490, and September, $19,623. The total loss for the four months was $146,049.

Figuring tonnage milled in those four months against net income from bullion, the recovery in June averaged $1.59 a ton; July, $1.06; August, $1.44; and September, $1.76.

President E. H. Walker states that the results of operation to date reveal that progress along sound business lines has been accomplished. Improvement has been made, as is indicated by the fact that tonnage, grade of ore, and mint returns, have increased while expenses and operating losses have decreased. Additional funds are needed to assist in the development and operation of the property.

London Financial News

LONDON, Nov. 6, 1928—A last appeal for funds has been made by Dolcoath, the famous old Cornish tin mine. This follows the call for £50,000 of debentures made last May, when only £9,500 was forthcoming, and since which time operations have been hampered. Lack of funds has prevented the extension of development work, though an increased tonnage has been treated, and additional separators and a slime plant have been erected. The treatment plant needs attention to prevent metallurgical losses which occur at present. Development on the 1,900 and 2,000 levels of the South lode show good ore, ranging from 42 to 112 lb. black tin per ton across the lode, the ore from this vein being easier to treat than that which was formerly mined from the "complex lode." Funds are necessary to push forward development in this area, and at last week's meeting an urgent appeal was made for £40,000 in convertible debentures. The response to the appeal has not been made public, but a current impression is that if not more than £30,000 is forthcoming, all subscriptions will be returned, in which event either liquidation or reconstruction will be the next development.

The one-time famous Cloncurry, Queensland, copper property is apparently to be given a new lease of life. The financial reconstruction of the Mount Elliott Mines, in which the New Consolidated Goldfields group has taken an interest, will allow some of the mines in this area to be reopened on a profitable basis. Improved metallurgy, better transportation, and cheaper fuel have brought within the ore definition large tonnages which it was not possible to treat under previous conditions, and which had, therefore, remained undeveloped.

The scheme now being discussed is not based solely on the known ore reserves, for it is expected that further development will disclose new oreshoots of sufficient importance to extend the present conservative estimate of the life of the mines in that region.

Interest attaches to a shipment of high-grade asbestos of the Soanesville Asbestos Syndicate, which I am told will soon reach London from the Pilbarra district of Western Australia. Several influential groups are now turning their attention to this field. These properties are now being opened up by H. R. Sleeman, and, according to latest reports, show profitable fiber continuously from 75 ft. to 140 ft., at which depth a drift 300 ft. long has been driven on the strike. Regular monthly shipments will be made, and the fiber is expected to fetch £160 and £90 for Nos. 1 and 2 grades respectively.

CONSOLIDATED MINING & SMELTING COMPANY, LTD., has exercised an option on 51 per cent of the stock of the George Copper Company, which owns prospects near Stewart, in the Portland Canal district. Option on another 42 per cent of the company's stock which does not expire until June, 1929, also is held by Consol. M. & S.

Central Eureka Stock Fiasco Develops Litigation

AS AN aftermath of the selling campaign of Preferred-A stock of Central Eureka Mining Company, H. Gutterman, according to the *San Francisco Chronicle*, has filed suit against J. V. Gally, editor of *Magazine of Western Finance*, Western Finance Publishing Company, D. A. Coplin, a broker, and the Bendac Corporation. The complaint alleges that the Bendac Corporation entered into an agreement with the Central Eureka Mining Company to buy 200,000 shares of that company's stock at $1.25 per share and that later the defendants conspired to create an artificial market for this stock in San Francisco and elsewhere in California and to unload the stock for more than its worth.

The Market Report

Large Scale Buying of Lead and Zinc Features Non-Ferrous Metal Markets

New York, Nov. 21, 1928—The re-entry of galvanizers into the Prime Western zinc market during the past week has resulted in the largest tonnage of sales reported in considerably more than a year. Lead buying has been in large volume also. Business in both metals includes a preponderance of big-tonnage transactions. Tin prices have advanced, with good consumer demand backed by speculative buying in London. Copper has sold in close to normal volume at virtually unchanged prices. Cadmium and arsenic prices are firm. Platinum and quicksilver are easy, with no quotational change.

Daily Prices of Metals

Nov.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
15	15.775	50.00	6.35	6.175	6.25
16	15.800	51.125	6.35	6.175	6.25
17	15.775	50.25	6.35	6.175	6.25
19	15.825	50.50	6.35	6.15	6.25
20	15.775	51.00	6.35	6.175	6.25
21	15.775	51.625	6.35	6.175	6.25
	15.788	50.583	6.350	6.171	6.250

Average prices for calendar week ending Nov. 17, 1928, are: Copper, 15.779; Straits tin, 50.063; N. Y. lead, 6.350; St. Louis lead, 6.183; zinc, 6.250; and silver, 58.083.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
15	68 3/16	68 5/8	74 3/4	228 1/2	224 3/8	21 1/8	21 3/8	24 11/16	24 1/2
16	68 1/16	68 7/16	74 3/4	229 1/8	224 3/8	20 15/16	21 3/16	24 11/16	24 1/2
19	68 3/16	68 5/8	74 3/4	230 3/8	225 1/2	21 1/8	21 3/8	24 11/16	24 11/16
20	68 3/16	68 5/8	74 3/4	231 7/8	227 3/4	21 1/8	21 3/8	25 1/8	25
21	68 7/16	68 13/16	74 3/4	233 3/4	229 1/2	21 3/16	21 3/8	25 3/16	25 1/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
15	4.84 3/8	58	26 3/4	84s11 1/2d	19	4.84 1/2	58	26 3/4	84s11 1/2d
16	4.84 7/16	58	26 3/4	84s11 1/2d	20	4.84 9/16	58	26 11/16	84s11 1/2d
17	4.84 7/16	58 1/8	26 13/16	.....	21	4.84 9/16	57 7/8	26 11/16	84s11 1/2d
						Ave.	58.000		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Normal Copper Market

Copper sales during the last week have been distributed with fair uniformity among the various agencies. The week's total is but slightly below normal. Several small orders for prompt deliveries have been accepted, and considerable January metal has been sold. February delivery continues to represent the largest proportion of the business, though some copper for March shipment has been sold.

Foreign business has been light this month, November sales to date approximating 25,000 tons. The statement issued by Copper Exporters, Inc., early this month, advising European interests to moderate their buying demand, is considered a major factor in this lessened requirement, though unsettled industrial conditions in Germany have adversely affected general conditions north of the Rhine.

Consumers in some of the high-freight rate areas of the Middle West have paid as much as 16.25c. per pound in sales reported by three or four producers. Consideration of these sales has been made in weighting the daily prices. Fabricators report demand for automobile consumption continuing at a high rate, with orders for delivery throughout the first quarter of 1929 coming in strong.

Lead Market Stronger Following Heavy Sales

This has been the best week in lead since the phenomenal buying of mid-September, one producer doing a particularly heavy business on practically every day of the last week. Most of the large consumers were in the market, taking from 200 to 500 tons each, and one order was placed for 750 tons; carload business was not so prominent a factor, though a fair amount of the smaller orders were placed, for prompt shipment. The more important business was mostly for December and January, a rather unusual condition in the lead market, where the consumers buy for much nearer delivery than do those of copper.

All of the business booked from Eastern refineries was on the basis of 6.35c., New York, which continues as the American Smelting & Refining Company's contract price. Chemical lead in the East brings about 5 points more. In the Middle West, chemical lead sold for 6.175c., St. Louis basis, with the exception of one day, Monday, when a temporary reduction to 6.15c. was made by one seller. The response at the slight concession was so whole-hearted that the 6.175c. level was re-established yesterday.

Cable manufacturers have been particularly active in the lead market, though a good tonnage has also been taken for ammunition, mixed metal, and battery manufacture, the last-named industry showing an increasing tendency to take corroding grades of lead. Paint manufacturers have had little or no part in the market this week.

London shows a slight upward ten-

dency today, which is encouraging, but it is thought that a more substantial advance on the other side will be necessary before the New York price can go back to 6½c.

Active Demand for Zinc

Prime Western zinc sellers report an active period of buying during the week ending today. The sales tonnage reported is the largest in nearly two years, though the price remains unchanged at 6.25c. per pound East St. Louis. Fairly heavy sales reported in the four preceding weeks, together with the exceptionally large volume of business done this week, lend credence to the statement that the Prime Western zinc industry has "turned the corner" which it has been seeking for so long. A considerable proportion of this week's business has been for delivery in the first quarter of 1929. Current shipments, however, have shown considerable improvement over those of recent months, and with the Tri-State production under moderate control the statistical position of the zinc-producing industry should show material improvement in the early future.

Tin Well Above 50c. Again

The Anglo-Oriental group that has been supporting the tin market in London continues to buy spot tin for warehouse storage, and has been successful in working the London quotation up to very nearly £234. Their policy has received much support this week from the American market, for the tin-plate interests have been heavy purchasers here for both prompt and forward metal. Also, the imminent functioning of the New York Metal Exchange as a speculative market for tin has been a strengthening influence. Prices for prompt Straits have advanced from 50c. a week ago to 51½c. today; forward is about one-half cent cheaper.

Silver Unchanged and Steady

Little change in silver has occurred in the last week, and prices remained the same, with the exception of Nov. 17, when 58⅛c. was quoted in New York. China was a small buyer, but as offerings were limited the market remained steady at the present level.

Mexican Dollars (Old Mexican pesos): Nov. 15th and 16th, 43⅞c.; 17th, 44c.; 19th and 20th, 43⅞c.; 21st 43¾c.

Canadian Exchange Above Par

Sterling continues near the gold-shipment point, but Canadian dollars have gone above par this week. Closing cable quotations on Tuesday, Nov. 20, were: Francs, 3.90$\frac{11}{16}$c.; lire, 5.24$\frac{15}{16}$c.; and marks, 23.83¼c. Canadian dollars, $\frac{7}{64}$ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 10⅛c. per lb. for all positions. Cookson's "C" grade, spot 15⅜c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 70@95c. Market active.

IRIDIUM — Per oz., $280@$300 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $42@$46. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $76, reduced from $78 per oz. on Nov. 8. Dealers and refiners quote the trade for refined metal, per oz., cash, for wholesale lots, $72@$73 bid, $73@$75 asked.

QUICKSILVER — Per 76-lb. flask, $123, cash. Small lots command the usual premiums. Market is very quiet.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Nov. 3.

Metallic Ores

Chrome, Iron, Manganese, Tantalum, Titanium, Tungsten and Vanadium ores are unchanged from quotations in the Nov. 3 issue.

Larger Demand in Tri-State District

Joplin, Mo., Nov. 17, 1928

Blende	Per Ton
High	$43.00
Premium blende, basis 60 per cent zinc	$40.00@ 41.00
Prime Western, basis 60 per cent zinc	39.00@ 40.00
Fines and slimes, 60 per cent zinc	34.00@ 36.00
Average settling price, all zinc	39.17
Galena	
High	$86.40
Basis 80 per cent lead	$85.00@ 82.00
Average settling price, all lead	83.90

Shipments for the week: Blende, 12,761; lead, 2,183 tons. Value, all ores the week, $683,020.

Two companies have resumed the six-day week. The attitude of other companies is unobtainable. Heavier buying, of a shipping tonnage more than 12,000 tons, suggests a permanent improvement in demand. The output has been consistently held under 12,000 tons per week for the last two and a half months, but shipments assumed a proportion greater than the output only in the last two weeks.

One buyer purchased a heavy tonnage of lead concentrate on a basis of $85, but other buyers assert they are paying but $82 basis today. Few sellers will accept the reduction, at least for several weeks, as many of the stock bins have been emptied.

Platteville, Wis., Nov. 10, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent lead	$85.00

Shipments for the week: Blende, 603 tons; lead, 40 tons. Shipments for the year: Blende, 32,590 tons; lead, 1,610 tons. Shipments for the week to separating plants, 947 tons blende.

Platteville, Wis., Nov. 17, 1928

Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$85.00

Shipments for the week: Blende, 498 tons; lead, 120 tons. Shipments for the year: Blende, 33,088 tons; lead, 1,730 tons. Shipments for the week to separating plants, 1,021 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Nov. 3 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

COPPER SULPHATE (Blue Vitriol)—Per lb. in carload lots 5½c.

Antimony Oxide, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Nov. 3 issue.

Alloys

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Monel Metal, Nickel Silver and Yellow (Muntz) Metal, are unchanged from prices in the Nov. 3 issue.

Rolled Metals

Copper, Lead and Zinc Sheets are unchanged from prices in the Nov. 3 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Nov. 3.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces Bessemer, $18.50@$19; basic, $18; No. 2 foundry, $18.

Steel—Base prices per gross ton. Pittsburgh, billets and slabs, $33@$34; plates, structural shapes, and soft steel bars, per lb., 1.90@2c.

Coke — Per gross ton, Connellsville furnace, $2.85@$3. Connellsville foundry, $3.75@$4.85. By-product coke. Ohio and Kentucky, $7; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended November 17, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	106	96¼	104⅜	Oc.13, No. 19 Q	1.00
Ariz. Com'l	Boston	5	4⅜	4⅜	Jl. 16, Jl. 31 SA	0.25
Cal. & Ariz	New York	123	117¼	121⅛	Se. 7, Se. 24 Q	1.50
Calumet & Hecla	Boston	46¼	44½	45⅛	No 30, De.15,Q	1.00
Cerro de Pasco	New York	110	103	107¼	Oc.11, No. 1 Q	1.25
Chile Copper	New York	68⅜	62	67⅜	De.5 , De.29 Q	0.75
Con. Coppermines	N. Y. Curb	15⅜	14⅛	15⅛		
Copper Range	Boston	25¼	24⅛	25⅛	Mr. 24, Ap. 20 A	1.00
Crystal Copper	Boston Curb	*27	*25	*27		
East Butte	Boston	4⅛	4⅛	4⅛	Dec., 1919	0.50
Granby Consol	New York	83	79	81½	Oc.11, No.1 Q	1.00
Greene Cananea	New York	167½	149½	163⅞	Se. 14, Oc.1 Q	1.00
Howe Sound	New York	69½	66⅜	69	Se.29, Oc.15, Q	1.00
Inspiration Consol	New York	38	35⅞	37⅜	Apr. 1927 Q	0.25
Isle Royale	Boston	26⅜	25⅛	26	Au.31, Se.15SAX	0.75
Kennecott	New York	146⅛	135¼	142½	Au.31, Oc 1 Q	1.50
Magma Copper	New York	66⅜	62	65⅞	Oc.1, Oc.15 Q	0.75
Mason Valley	N. Y. Curb	2	1⅞	2		
Miami Copper	New York	30	26⅛	29⅞	No.1, No.15, Q	0.37½
Mohawk	Boston	*41	35⅛	36½	Oc. 31, De. 1 Q	3.00
Montana-Idaho	Spokane	*12	*9	*9½		
Mother Lode Coal	New York	3⅜	3⅛	3⅜	Je.8, Je. 30, SA	0.15
Nevada Consol	New York	36⅜	34	36¼	Se.14, Se.29 Q	0.37½
New Cornelia	Boston	45	41½	42	No.2, No. 19 Q	0.50
Noranda	N. Y. Curb	55⅛	53	53⅜		
North Butte	Boston	6⅜	5⅞	6⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*85	*70	*80	Sept., 1926	0.03
Old Dominion	Boston	16⅛	15	16⅛	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	196	188	196	Se.10, Oc.1 Q	2.00
Quincy	Boston	48⅛	40	48⅛	March, 1920	1.00
St. Mary's Min. Ld	Boston	38⅛	35	36⅞	Ap.1928 A	2.00
Seneca Copper	New York	6⅛	5⅜	5⅜		
Shattuck-Denn	N. Y. Curb	20	18⅞	19		
Tenn. C. & C	New York	18	16⅜	17⅛	Au., 31 Se.15,Q	0.25
United Verde Ex	N. Y. Curb	29⅛	22⅛	23⅛	Oc.6, No.1 Q	0.50
Utah Copper	New York	250	240	246	Se.14, Se.29 Q	2.00
Utah Metal & T	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	2.52½	2.00	2.00		
NICKEL-COPPER						
Internat. Nickel	New York	201	191	195½	Se.10, Se.29 Q	0.75
Internat. Nickel pfd.	New York	120½	120	120	Oc.1, No.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*5	*4⅛	*5	June, 1927	0.005
National Lead	New York	122½	120	120½	De.14, De.31 Q	1.25
National Lead, pfd. A	New York	142	140½	141	No.3, De.15 Q	1.75
National Lead, pfd. B	New York	118	118	118	Ja. 18, Fe.1 Q	1.50
St. Joseph Lead	New York	46⅛	44½	45	Se.8, De.20 QX	0.75
ZINC						
Am. Z. L. & S	New York	46	43½	45	May, 1917	1.00
Am. Z. L. & S. pfd	New York	102	100½	101½	Nov., 1920	1.50
Butte C. & Z	New York	9⅛	8	8⅛	De., 1926	0.50
Butte & Superior	New York	10⅞	10	10½	Se.14,Se.29 Q	0.50
Callahan Zn-Ld	New York	3½	3	3⅛	De., 1920	0.50
Consol.Lead&Zinc 'A'	St. Louis	10⅛	10	10	Je.25, Jl.1 Q	0.25
Eagle-Picher	Cincinnati	19¼	18⅛	18⅞	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	100	July 15 Q	1.50
Evans-Wallower	N. Y. Curb	12⅞	9⅞	10		
New Jersey Zn	N. Y. Curb	241	230½	241	No. 20, De. 10 X	2.00
Treadwell-Yukon	Toronto	13	12	12½		
United Zinc	N. Y. Curb	1.00	*75	1.00		
Yellow Pine	Los Angeles	...	...	*25	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	9⅛	8⅛	8⅛		
Ankerite	Toronto	...	...	*22		
Barry-Hollinger	Toronto	*40	*35	*36		
Central Manitoba	Toronto	*83	*80	*81		
Cresson Consol. G	N. Y. Curb	*96	*75	*90	Oct. 15, Q	0.02
Dome Mines	New York	8⅞	8⅛	8⅛	Se.29, Oc.20 Q	0.25
Gold Hill	Toronto	*10	*8½	*9		
Golden Cycle	Colo.Springs	†1.63	†1.61	...	My. 31, Je.10 Q	0.04
Hollinger Consol	Toronto	9.00	8.35	8.35	No 14, De. 1 M	0.05
Homestake Mining	New York	*80	*80	*80	No.15, De.1 M	0.50
Kirkland Lake	Toronto	1.10	1.05	1.06		
Lake Shore	Toronto	19.20	18.20	18.50	De.1, De.15 Q	0.20
McIntyre Porcupine	New York	20⅛	19⅜	19⅞	No.1, De.1 Q	0.25
Portland	Colo.Springs	†*15	*†11	....	Ap., 1927	0.02
Rand Mines	New York	...	...	36½	Au.21-28 Am.Sh	1.52
Sylvanite	Toronto	2.25	2.15	2.20		
Teck-Hughes	Toronto	8.90	8.65	8.70	Oc.17, No.1	0.15
Tom Reed	Los Angeles	...	...	*49	Dec., 1926	0.02
Tough-Oakes	Toronto	*13½	*8	*8½		
Vipond Cons	Toronto	*60	*57	*58	April, 1927	0.03
Wright-Hargreaves	Toronto	2.53	2.30	2.33	Oc.16, No.1 Q	0.02½
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	25¼	22	25⅛		
Con. Cortez	N. Y. Curb	...	...	*19		
Dolores Esperanza	N. Y. Curb	*96	*96	*96	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	15	14⅜	14⅜	Oc.17, Oc.27 QX	0.50
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛	Se.14, Oc.4 Q	0.06
Tonopah Belmont	N. Y. Curb	*75	*74	*75	Oc., 1925	0.05
Tonopah Extension	N. Y. Curb	*8	*7	*8	Ap., 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Se 29,Oc.20 SA	0.07½
West End Consol	N. Y. Curb	....	...	*3	Mar., 1923	0.05
Yukon Gold	Boston Curb	*73	*63	*70	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	*60	*60	*60	May, 1920	0.03
Castle-Trethewey	Toronto	*40	*39	*40		
Coniagas	Toronto	3.25	3.00	3.00	May, 1924	0.12
Keeley	Toronto	*40	*40	*40	Mr.1, Mr.15 SA	0.04
Lorrain Trout Lake	Toronto	*30	*30	*30	July, 1925	0.05
Mining Corp. Can	Toronto	3.75	3.15	3.60	De.6, De.20 SA	0.12½
Nipissing	N. Y. Curb	3	2⅛	2⅛	Se.29, Oc.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	3⅞	2⅛	3⅛	Ap., 1927	0.12
Bingham Mines	Boston	47	44½	47	Se.20, Oc. 5 MX	0.50
Bunker Hill & Sullivan	N. Y. Curb	139¾	139¾	139¾	Oc. 31,No. 5 X	0.75
Cardiff M. & M	Salt Lake	*30	*30	*30	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.00	3.95	3.95	Ja.10, Fe.1 K	0.10
Consti'n Mng.&Mill'g.	Spokane	*48	*48	*48		
Erupcion	Boston Curb	*30	*30	*30	Ja , 1928 Q	0.07½
Eureka Lily	Salt Lake	1.57½	1.55	1.55		
Federal M. & S	New York	177	170	177	Je., 1927	10.00
Federal M. & S. pfd	New York	101	101	101	No. 23, De. 15 Q	1.75
Golconda	Spokane	*82	*76½	*79½		
Hecla Mining	N. Y. Curb	17⅞	16⅜	17	No.13, De.14 Q	0.15
Highland-Surprise	Spokane	*13	*12½	*12⅜		
Iron King Mining	Salt Lake	*91	*90	*90		
Keystone Mining	Salt Lake	†*20	†*20	...	Fe., 1926	0.07½
Lucky Jim	Spokane	*24	*24	*24		
Lucky Tiger-Com	Kansas City	†6.75	†6.50	...	No.4, No.20 M	0.05
Mammoth Mining	Salt Lake	†1.30	†1.10½	...	De., 1926	0.25
North Lily	Salt Lake	8.25	8.10	8.10	Oct., 20 I	0.20
Park Utah	New York	10⅜	10⅛	10⅜	Se., 11, Oc.1 Q	0.20
Plutus Mining	Salt Lake	†2.00	†2.00	...	Ap.10, Ap.16 Q	0.10
Rico-Argentine	Salt Lake	*49½	*49	*49	June 15 Q	0.03
Sherman Lead	Spokane	*28½	*25	*25½		
Silver King Coal	Salt Lake	13.25	13.00	13.00	Se.20, Oc.1 Q	0.25
Silversmith	Spokane	*9	*8	*8⅛	Oct., 1926 Q	0.02
Strattons Mines	Spokane	1.62	1.40	1.60		
Sunshine M. Co	Spokane	1.30	1.20	1.27	June 20, K	0.02
Tamarack-Custer	Spokane	*43	*41	*41	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.62½	13.25	13.50	Se.19, Se.29 QX	0.30
Utah-Apex	Boston	4	3⅜	3⅜	Jl.14, Au.1 K	0.25
IRON						
Bethlehem Steel	New York	81	67⅜	80⅞	Jl., 1924	1.25
Cleveland-Cliffs Iron	Cleveland	140	135	140	Oc.15, Oc.25. Q	1.00
Colorado F & I, pfd	New York	82½	73½	78	Au.10, Au.25 Q	2.00
Gt. North'n Iron Ore	New York	29⅛	28⅛	28⅜	Ap. 9, Ap. 30 K	0.75
Inland Steel	New York	76	74	75⅞	No. 15, De.1 Q	0.62½
Republic I. & S	New York	90⅜	83⅜	88⅜	No. 14, De. 1 Q	1.00
Republic I. & S. pfd	New York	110⅜	110½	110⅜	De. 14, Ja. 2 Q	1.75
Sloss-Sheffield S. & I	New York	127⅜	116½	126	Se.10, Se.20 Q	1.50
Sloss-Snef. S.&I. pfd	New York	110½	109	110⅛	Se. 20, Oc. 1 Q	1.75
U. S. Steel	New York	172½	164¼	171¼	No.30, De.29 Q	1.75
U. S. Steel, pfd	New York	141⅛	141	141¼	No. 3, No.28 Q	1.75
Virginia I. C. & C	New York	25½	25½	25½	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	52¼	47	52¼	Je. 16, Jl. 2 SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	23	23	23	Ju.16, Ju.26 K	0.97
So. Am. G. & P.	N. Y. Curb	3½	3⅛	3¼		
Alum. Co. of Amer.	N. Y. Curb	139	136	138		
Alum. Co. of Amer. pf.	N. Y. Curb	107	106⅛	106⅛	Se. 15, Oc. 1 Q	1.75
Vanadium Corp	New York	111⅛	100⅛	103⅜	De.1,De. 15 QX	1.75
Patino M. & E	New York	36⅛	34	35⅛	April, 1928	4s.
ASBESTOS						
Asbestos Corp	Montreal	21	20	20⅛	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	75	75	75	Se.29, Oc 15 Q	1.75
SULPHUR						
Freeport Texas	New York	49	47	48⅛	Oc.15, No.1 QX	1.25
Texas Gulf	New York	80⅛	73⅛	80⅛	De. 1, De 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	51⅛	49⅞	50⅛	No. 20, De 1 Q	0.75
Amer. Metal, pfd. 6%	New York	...	...	113	No.20, De.1 Q	1.50
Amer. Sm. & Ref	New York	285	274½	284	Oc.11, No.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	137⅛	137	137⅛	No.2, De. 1 Q	1.75
Consol. M. & S	Montreal	295	292	292	Je.30, Jl.16 SAX	6.25
Newmont Mining	N. Y. Curb	196⅛	186⅛	195⅛	Se.28, Oc.15 Q	1.00
U. S. Sm. R. & M	New York	58⅛	57	58⅛	Oc.5, Oc. 15 Q	0.87½
U.S. Sm. R.&M. pfd	New York	54	53⅛	54	Oc. 5, Oc. 15 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. A, Annual. SA, Semi-annually. M, Monthly. FW, four weeks. K, irregular. I, Initial. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED November 6, 1928

Name	High	Low	Last	Date	Last Div. Amount
Alaska Mexican ($5)	21/3	18/9	20/--		
Alaska Treadwell ($25)	120/6	120/—	120/—	Nov., 1926	4 (d)
Aramayo Mines (25 frs.)	59/4½	58/9	58/9	Aug, 1928	5 p.c. (†)
Burma Corpn. (10 rupees)	14/6	13/10½	14/1½	Aug., 1928	6 annas*
Bwana M'Kubwa (5s)	8/4½	7/9	8/4½		
Camp Bird (2s)	4/—	3/3	3/6	April, 1928	16⅔ p.c.
El Oro (£1)	5/1½	4/6	5/—	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	8/9	8/6	8/9	July 1928	3¾ p.c.
Mexican Corpn.(£1)	10/3	9/9	10/3		
Mexico Mines of El Oro (£1)	30/—	26/3	30/—	Dec., 1926	3¾ p.c.*
Mond Nickel	138/9	130/7½	137/6	Aug., 1928	20 p.c.
Mount Isa (£1)	34/3	33/1½	33/9		
N'Changa Copper Mining	20/7½	18/9	20/—		
Oroville Dredging (£1)	3/10⅛	3/6	3/9	Dec., 1923	3¾ p.c.
Rhodesian Congo Border (£1)	33/—	31/6	32/6		
St. John del Rey (£1)	12/6	11/10½	12/—	April, 1928	7½ p.c.
San Francisco Mines (10s)	29/9	28/9	29/3	July 1928	12½ p.c.
Santa Gertrudis (£1)	14/7½	14/—	14/3	July 1928	7½ p.c.
Selukwe (2s. 6d.)	8/—	7/1½	7/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	2/4½	2/—	2/1½	Nov., 1917	75 p.c.
Tanganyika (£1)	63/9	60/7½	61/3	July 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	11,300	11,135	11,140	July, 1928	182.60 (b)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.